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CONCHOLOGY

VOL. XXIII

APPENDIX TO
AMASTRIDÆ. TORNATELLINIDÆ

INDEX, VOLS. XXI–XXIII

BY

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PREFACE

The present volume, mainly concerned with the Family Tornatellinidæ, completes a trilogy treating of the snails of Pacific Islands, chiefly of the Hawaiian Islands; the other volumes deal with the Families Amastridæ and Achatinellidæ.

Together with the Partulidæ (Volume XX) these are numerically the most important families of the land-snail faunas of the Pacific. They also comprise nearly all of the large land snails of these faunas. Members of the Superfamily Orthurethra, these primitive land snails, dispersed in the Palæozoic, parallel the Sigmurethra in their adaptations. There are terrestrial and arboreal types, and cylindric, conic, Bulimoid, Achatinoid and Helicoid shell-forms. This remarkable parallelism has caused the Orthurethrous genera to be scattered, in former classifications, among the series of continental families of the Superfamily Sigmurethra, an arrangement which ignored the structural features of the pallial organs.

Of the 219 species and 44 subspecies or named varieties described in this volume, 93 species and 38 subspecies are here defined for the first time. The type-specimens of 168 of the species and subspecies have been examined by one or (usually) both of the authors; also cotypes, paratypes or specimens from the original lots of many other species. Thirty-seven of the species and subspecies herein described have not been seen by either author. Part of these are nominal species, known only by the original descriptions, not subsequently identified by authors or collectors.

As half the world separated the authors during the preparation of the manuscript, it was not always possible to collaborate upon every point. The first part of the work, up to p. 68, was therefore chiefly by the senior, the succeeding pages, up to p. 113, mainly by the junior author. In the rest of the book the work is mingled in every genus. The Hawai-

ian species were worked up in great part by the junior, other species by the senior author; but in many cases throughout the work both authors contributed material on the same species. The primary responsibility for the new species is indicated by the sequence of author's initials following the specific names. Both authors have had the advantage of studying Tornatellinidæ in the field.

The present study of Tornatellinidæ is based, for the most part, on the collection of the Bishop Museum, containing nearly 3,000 lots from the Hawaiian Islands, including Mr. Ancey's Hawaiian collection and types, and on the collection of the Academy of Natural Sciences, about 500 lots from nearly all regions inhabited by these snails.

Mr. Samuel Henshaw, of the Museum of Comparative Zoology, has generously permitted examination of the material in his charge, including part of the types of W. H. Pease. We are indebted to Mr. W. F. Clapp for a MS. catalogue of Tornatellinidæ and Achatinellidæ in the same museum.

Dr. Wm. H. Dall allowed us to study and illustrate certain specimens in the United States National Museum.

Mr. Tom Iredale sent the material he had collected in the Kermadec Islands.

Certain types in the British Museum we are able to figure by the kindness of Mr. E. A. Smith.

The privilege of studying material from the Newcomb collection we owe to Professor G. D. Harris, of Cornell University.

Messrs. D. Thaanum, of Hilo, and Irwin Spalding, of Honolulu, have opened their great Hawaiian collections to us. Many of our new species are testimonials to their ability in the field.

We are also sensible of the continued encouragement afforded by the President and Publication Committee of the Academy of Natural Sciences of Philadelphia and the Director and Trustees of the Bishop Museum, Honolulu.

H. A. P.
C. M. C.

Philadelphia and Honolulu,
February, 1916.

INTRODUCTION

KEY TO THE GENERA OF TORNATELLINIDÆ.

a. Shell imperforate, the columellar axis solid throughout.
  b. Shell globose or broadly ovate; columella conspicuously calloused.
    c. Whorls few, 3 to 4½; apex large; columellar callous bilobed; aperture and throat ample (pl. 28, fig. 6). ELASMIAS, p. 113.
    *c*¹. Whorls about 6 or 7; apex small; columella having numerous, deeply entering lamellæ, obstructing the throat (pl. 28, figs. 10-12). LAMELLOVUM, p. 131.
  *b*¹. Shell ovate, ovate-conic, oblong or turrited-conic; columella often lamellate but not heavily calloused within.
    c. Lip thin, sharp and unexpanded; shell thin or fragile, uniform brown or corneous, dextral. TORNATELLINA, p. 132.
    *c*¹. Lip more or less expanded, not sharp; shell moderately strong or solid, often dark or bright colored or banded. AURICULELLA, p. 71.
*a*¹. Shell perforate or umbilicate in the last whorl, above which the axis is solid.
  b. Lip expanding, thickened within or blunt-edged; shell often strongly colored or banded. AURICULELLA, p. 71.
  *b*¹. Lip not expanding, thin and sharp-edged; shell small (3½ mm.). GULICKIA, p. 112.
*a*². Shell perforate or umbilicate, the axis perforate throughout; thin or fragile, less than 6 mm. long.

b. Oviparous; whorls usually almost flat.
TORNATELLARIA, p. 251.

b[1]. Viviparous; whorls usually convex.
TORNATELLIDES, p. 192.

NOTES ON THE CLASSIFICATION OF TORNATELLINIDÆ.

The systematic study of this family was begun by Beck (1837), Anton (1839) and Pfeiffer (1842). Dohrn also discussed the system in 1863 (Malakozoologischer Blätter X, p. 156). Many naturalists, among whom we may mention Harper Pease, Andrew Garrett, C. F. Ancey and O. von Moellendorff, have contributed descriptions of species, the old genus *Tornatellina* becoming thereby more and more heterogeneous.

An illustrated monograph of *Tornatellina* was published about 1850 by H. C. Kuester, in the *Systematisches Conchylien-Cabinet* (15 species). Pfeiffer, in his *Nomenclator* of 1878, enumerated about 60 species of *Auriculella* and *Tornatellina*, descriptions of which had appeared in the successive volumes of his *Monographia Heliceorum*.

A new classification of these snails was offered by the senior author in a synopsis of the genera published in 1910. This classification is fully worked out, with additions by both authors, in the present volume.

The family now numbers 174 species and 20 subspecies, exclusive of those ascertained to be synonyms. Some 10 or 12 of these species are of doubtful standing. About 45 per cent of the known species and subspecies are first described in this volume.

A sequence of the genera better than that given in the text follows, related genera being bracketed together:

{ Lamellovum.
{ Elasmias.
Tornatellina.
Tornatellides.
{ Tornatellaria.
{ Gulickia.
{ Auriculella.

An entirely satisfactory classification of the genera is naturally not to be expected until we are acquainted with their soft anatomy. *Elasmias, Tornatellina* and *Tornatellides* are viviparous, *Tornatellaria, Gulickia* and *Auriculella* being oviparous. The mode of reproduction probably indicates real affinity between the last three genera, especially as there are other features of likeness. All of them are confined to the Hawaiian group. They seem to be arboreal and terrestrial adaptations of an old indigenous stock.

Elasmias has a rather primitive, infantile aspect, resembling the embryonic stage of other genera, as noted on page 114. The two genera having the axis perforate, *Tornatellides* and *Tornatellaria*, are probably not closely related, though superficially similar.

Auriculella has the shell-axis solid, though often the last whorl deviates, leaving a shallow umbilicus. Its special features are those adaptive characters common to arboreal land snails of many families—varied coloring, spreading lip and smooth surface. It seems significant that the *Auriculella-Gulickia-Tornatellaria* group, like the *Achatinellidæ*, does not occur on Kauai. Both groups are exclusively Hawaiian, both are confined to humid forest regions, and their distribution seems to have been controlled by the same conditions.

Distribution of Tornatellinidæ.

This family is almost wholly confined to the islands of the Pacific, but a few species occur in the East Indies and as far west as Mauritius (1 genus). Eastward, a few inhabit the American islands Juan Fernandez, Masafuera and the Galapagos (2 genera). The Bonin Islands and islands of Izu, Japan, are the northern limit (3 genera), and New Zealand (2 genera) the southern. The total range lies between 34 N. and 40 S. latitude, and from 80 W. longitude westward to about 60 E.

Tornatellina, Tornatellides and *Elasmias* are the most widely distributed genera. *Lamellovum* is restricted to the single island of Rapa. *Auriculella, Gulickia* and *Tornatellaria* are solely Hawaiian, where they have exactly the dis-

tribution of the *Achatinellidæ*, being absent from Kauai. The Hawaiian archipelago has by far the greatest number of genera and species, having representatives of all the genera except *Lamellovum;* but Polynesia, Micronesia and Melanesia have not been so fully explored.

What we know of the distribution and structure of Tornatellinid snails suggests that the group is of great antiquity. It has probably had since Palaeozoic times to acquire its present distribution. Yet the presence of closely related species on separate island groups indicates that some emigration has been in progress up to recent times, whether by wind or flotsam, or both, is uncertain. A few of the species which occur on low islands, and near the shore of others, have in all probability been transported from island to island by human agency, as they cling to leaves and stems of plants and other objects, and might be picked up in any cocoanut grove.

Large accessions to the list of species now known may be expected from the Hawaiian Islands, Polynesia, Micronesia and Melanesia, particularly from the high islands. Rapa and Juan Fernandez are points of especial interest for further investigation.

Terminology of the Stages of Growth.

The shells of most *Tornatellinidæ* change remarkably in structure during the development of the individual. The characters of adolescent stages often indicate relationship not expressed by the adult stage. In the discussion of these stages we have used the well-known modified Hyattian terminology of the stages of growth and decline, as follows:

Oönic. Egg, up to maturation.

Embryonic. From fertilization to the culmination of podocyst, primitive kidney and other specially embryonic structures. As the succeeding (nepionic) stage is not distinguishable in shells of Tornatellinidæ, "embryonic" is here practically used to cover the stage ending with birth or escape from the egg capsule.

Nepionic. Babyhood. Scarcely or not recognizable in the shell, in this family, and in practice included in the embry-

onic. The nepionic shell-record is always brief in pulmonates —the fractional part of a whorl—but in many genera it is legible. Developmentally important, since it includes the decline and disappearance of embryonic structures, such as the podocyst, and rapid development of kidney and other neanic structures; terminates with birth.

Neanic. Youth, up to the completion of the shell, which is usually coincident with the time of reproductive activity.

Ephebic. Maturity.

Gerontic. Old age.

Each of these stages may be subdivided by use of the prefixes ana-, meta-, para-. Thus *ananeanic* signifies an early neanic substage; *metaneanic*, mid-neanic; and *paraneanic*, a late neanic substage, or almost full grown.

It will be noted that many Tornatellinid snails are phylogerontic, or in the old age of the race, shown by the culmination of structural differentiation in the neanic stage, with simplification in the later stages. Many instances are noted under *Lamellina, Tornatellides* and other genera. It is an indication that such genera are geologically old. This conclusion is supported by the facts of distribution, for several of the genera range over islands scattered from side to side of the Pacific, where the facilities for migration of land animals must be the least favorable.

SUPPLEMENT TO VOL. XXI.

During the visit of the senior author to the Hawaiian Islands in 1913, large accessions were made to the material studied in the preparation of the Vol. XXI; part from collections made by the authors, part from the latest finds of Messrs. Thaanum and Spalding. This material is herein described.

Family AMASTRIDÆ Pilsbry.

Subfamily LEPTACHATININÆ Ckll.

Letachatinini COCKERELL, Science (N. S.) Vol. 37, p. 256 Feb. 14, 1913).

Genus LEPTACHATINA Gould.

L. POPOUWELENSIS P. & C., n. sp. Pl. 9, fig. 4.

The shell is imperforate, narrow, the diameter slightly less than one-fourth the length; cinnamon-colored, glossy, weakly marked with growth-lines. Whorls 7⅔, somewhat convex, the last laterally flattened, tapering at the base. The aperture is oblique, piriform. Outer lip is thin, obtuse, and arches forward at the upper third. Columella short, obliquely truncate below; fold weak. Parietal callus thin. Length 8, diam. 2.1 mm., length of aperture 2.2 mm.

Oahu: Western ridge of Popouwela, Spalding, Cooke and Pilsbry. Type 110596 A. N. S. P.

This species resembles the slender forms of the Diamond Head Pleistocene. *L. exoptabilis* has a larger aperture and differently shaped lip. In *L. leiahiensis* the columella differs. *L. scutilis* has a much larger summit, and is less slender.

L. SAGITTATA P. & C. n. sp. Pl. 11, fig. 9.

The shell is minutely perforate, similar to *L. lanceolata* but more slender, light cinnamon, glossy, with faint growth striæ; summit very obtuse, whitish. Outer lip obtuse, not thickened. Columella straight in front view, its edge reflected over the perforation. In oblique view in the aperture a small, vertical lamella may be seen, standing at a right angle with the plane of the peristome, further in and stronger than in *L. lanceolata*. Length 6.2, diam. 2.2 mm.; 6½ whorls.

Molokai: Pipe-line trail, upper Kaunakakai. Cooke & Pilsbry, Jan., 1913.

L. molokaiensis, with six whorls, is a larger shell, having the columella more sinuous, and the columellar margin appressed. *L. lanceolata* is a more conic shell with wider last whorl. It is common in the same station with *L. sagittata*.

L. LANCEOLATA Cooke. Vol. XXI, 65.

Pipe-line trail in upper Kaunakakai; northwestern ravine of Kamalo (Cooke & Pilsbry).

L. TRITICEA (Gulick). Vol. XXI, pl. 3, fig. 52.

"Shell dextral, imperforate, elongately ovate, thin, shining, pellucid, pale corneous, very finely striated; apex somewhat acute, pallid; spire convexly conic; suture simple, lightly impressed; whorls 6½, rather convex; columellar fold central, white, sublamelliform. Aperture sinuately pyriform; peristome scarcely thickened within; with dextral margin unreflected, arcuate; columellar margin dilated, corneous, adnate; parietal margin wanting. Length 8⅓, breadth 4, length of body-whorl 5⅓ mm. Average weight .17 grains." (*Gulick.*)

Oahu: Keawaawa, on the ground (J. T. Gulick!).

Achatinella triticea GULICK, Annals of the Lyceum of Natural History of New York, vi, 1856, p. 184, pl. 6, f. 12.—*Leptachatina triticea* Guliek, SYKES, Proc. Malac. Soc. London, iii, p. 276, pl. 14, f. 8, 1899.—*L. tritacea* Gulick, COOKE, Man. Conch. xxi, p. 28.

"Smaller and more elongately ovate than the preceding" [*L. fragilis*]. Var. *b*. Smaller, more solid, ovate conic, with lip thickened (*Gulick*).

Doubtless close to *L. oryza* Pfr., but the columella and parietal callus are thin and the shell is imperforate.

L. ORYZA (Pfeiffer). Pl. 10, figs. 1 to 9.

Vol. XXI, p. 28, pl. 3, figs. 60, 61 (*not* 59). An error in Vol. XXI to references to figures of this species and *subcylindracea* would pretty effectually prevent their proper identification. Figs. 60, 61, of Vol. XXI, are not quite typical, being a little too conic. Pl. 10, fig. 1 is from the type in the British Museum.

The species is especially characteristic of the Pleistocene and later beds in Oahu, found in many deposits in different parts of the island. At about the same time, its close relatives existed on other islands: *antiqua* in Kauai; *avus* in Molokai; *isthmica* in Maui; *defuncta* in Hawaii—all now extinct.

L. oryza was sent to Pfeiffer by Frick, who certainly collected on the northern coast of Oahu from Kahuku eastward, as we know by the Bulimellas he obtained, among other things. The description agrees well with specimens from the neighborhood of Kahuku, where several deposits containing *L. oryza* are adjacent to the road. This place was also, probably, the source of Newcomb's specimens of *oryza*, which were figured in Vol. XXI, pl. 3, figs. 60, 61. The recent form from Keawaawa described by Mr. Gulick as *Ach. triticea* (misprinted "*tritacea*" in Vol. XXI, p. 28) may prove to be distinct from *oryza*, and the original description is reprinted above. All of the localities represented in collections made by the authors in 1913 are noted here, to show the general distribution of this common Pleistocene species along the north and west and part of the south coast of Oahu. In some places it occurs by myriads.

In typical *L. oryza* the striation is distinct, more emphatic near the suture, where the striæ bend backward a little. The roughness is slightly exaggerated in pl. 3, fig. 60, of Vol. XXI.

The axis varies from "subrimate" to distinctly perforate. The face of the columella is thickened, and the parietal callus is rather strong. The columellar lamella recedes, and is scarcely or not visible in a direct face view, but the shell need be turned very little to show it like Vol. XXI, pl. 3, fig. 61. That shell measures, length 8.1, diam. 3.8 mm. (No. 57822 A. N. S.)

Diamond Head, in the cutting of the ocean road and above it; around the tunnel on the N. W. side; floor of the crater, and in the breccia along the ascent to the lookout (Cooke, Bryan and Pilsbry). *L. oryza* is common everywhere in the Diamond Head deposits, but the most perfect come from the inside of the crater around the "lake" (pl. 10, figs. 7, 8). The parietal callus and columellar margin are especially thick; the striation is faint or nearly effaced except close to the suture; and the umbilical crevice is very small or even closed. Sometimes the columellar lamella emerges; sometimes it is not visible in a front view. The size varies from length 10, diam. 4.1 mm., to length 9, diam. 4 mm. It occurs also in the bench of consolidated calcareous sand which extends eastward of Diamond Head.

Punchbowl, about 300 ft. above the summit, and about two feet below the surface, specimens were taken by Prof. Wm. Alanson Bryan.

The Kailua specimens occurred in a raised bench of calcareus sand-rock about ¼ mile from the north shore (Pilsbry). See pl. 10, fig. 9. They have the columellar lamella more prominent in front view, and the size averages smaller, than in shells from Diamond Head, length very little more or less than 8 mm. At Laie the shells are from a dune deposit utilized as a sand pit by the railroad. It is west of the stream, between the road and the sea. The shells vary in prominence of the columellar lamella, and are sometimes imperforate. Length 6.3 to 8 mm., but there are very few of the larger shells, 7 x 3 mm. is a common size.

At the deposit 1½ miles east of Kahuku (pl. 10, figs. 3, 4, Cooke & Pilsbry) the shells are a little more strongly striate than those from eastward, and 8 mm. long. In another place

in the sand dunes near the shore, there are small shells, like those of Laie.

Pl. 10, figs. 5, 6. The shell deposits on benches of the high coral bluff 1½ miles west of Kahuku are very rich in Leptachatinas. The *oryza* are usually markedly conic in shape, quite different from the cylindric race of Diamond Head. The perforation is very narrow or closed, and the columella is shortened. Size from 8 x 3.7 to 7 x 3.3 mm.

L. oryza hesperia n. subsp. Pl. 10, figs. 10, 11.

The shells vary from openly perforate to nearly closed, have weak, irregular, not very fine, wrinkles of growth, stronger below the suture. The columellar lamella is stronger within than in *oryza*, and projects subhorizontally. Columellar margin and parietal callus heavy.

Length 9.3, diam. 4.1, aperture 4 mm., 7 whorls (usual size).

Length 7, diam. 3.5 mm., 5½ whorls (small, obese form).

Length 7, diam. 3.1 mm., 6⅓ whorls (small narrow form).

Oahu: Kawaihapai, in soil of a plowed field between the railroad and the bluff, and on the latter. Haleiwa, on the golf links, in superficial deposits of calcareous sand (Cooke and Pilsbry).

In the Haleiwa shells the perforation is almost closed, or rarely entirely so. They measure 9 x 4 to 7.5 x 3.8 mm.

It is smaller and usually a little narrower than *L. captiosa*, with less ample aperture and more horizontal columellar lamella.

L. ORYZA AVUS Pilsbry & Cooke, n. subsp. Pl. 10, figs. 12 to 16.

The shell is imperforate, cylindric, the upper third tapering, conic; solid, very lightly sculptured with inconspicuous growth-wrinkles, which are stronger, regular, and retracted below the suture, when unworn. Whorls very slightly convex. The suture ascends slightly in the last third or half whorl. Aperture vertical, the outer lip obtuse, rather thick. Columella concave above the fold which is moderately prominent in front view, rather strong within. Columellar margin thickened, reflected. Parietal callus thick.

Length 10.5, diam. 4.5, length aperture 4.2 mm.; 7¾ whorls.

Length 9.5, diam. 4.1, length aperture 4 mm.; 7 whorls.

Length 9, diam. 4, length aperture 3.4 mm.; 7 whorls.

Molokai: Sand dunes of Moomomi, Pleistocene (Cooke and Pilsbry). Cotypes in coll. A. N. S. P. and Bishop Museum.

An abundant and characteristic fossil of the dune-covered deposits, from the shore three-fourths of a mile inland, and about 600 ft. up the bluff.

The stout, rather prominent columellar lamella and the weaker striation, differentiate this Molokai race from *L. oryza* of Oahu,—not that we would give the impression that the differences are startling. The shape and size vary within wide limits. It is extremely abundant. The surface is usually etched by blowing sand, but perfect shells can be obtained in the soft layers of the bluff, and also from the reddish earth underlying the dunes.

Want of specimens at hand prevents a comparison with *L. isthmica* of Maui, which is evidently very close to the Moomomi race, if not the same.

L. DORMITOR P. & C., n. sp. Pl. 11, fig. 3.

The shell is imperforate, cylindric-conic, the upper half tapering to a conspicuously obtuse apex, nearly smooth; slightly marked with growth-wrinkles, not more strongly striate under the suture. In the best preserved examples a dark brown band borders the suture below. The aperture is rather small, outer lip obtuse, somewhat thickened. Columellar margin sinuous, reflected and adnate, not or but little thickened on the face, passing into a rather thick parietal callus. Columellar lamella emerging conspicuously, and in oblique view thin, but broad and somewhat approaching a horizontal direction.

Length 9.6, diam. 4.1, aperture 4 mm.; nearly 7 whorls.

Length 10, diam. 4.1, aperture 4 mm.; 7 whorls.

Length 9, diam. 4.1 mm.

Molokai: near the top of Mauna Loa, at about 1350 ft. elevation, on the south side of the "crater" (Cooke & Pilsbry).

A Holocene fossil. With much the shape of *L. oryza avus*,

this is a thinner shell, without more conspicuous subsutural striation, and with a sharper columellar lamella. At the top of Mauna Loa, probably the last refuge of *Achatinellidæ* in western Molokai, it survived until the human period, as it was found there in artificial stone piles (sweet potato hills), associated with *Amastra, Partulina d. occidentalis*, and many small land shells.

L. SOMNIATOR P. & C., n. sp. Pl. 11, figs. 4, 5.

The shell is perforate or closed, oblong-conic, rather thin, the outlines of the spire convex below, straight near the obtuse apex; surface faintly marked with growth-striæ, which are stronger below the suture. Whorls hardly convex. Aperture somewhat piriform, the outer lip thin, obtuse, more curved in its lower half; columellar margin reflected, thickened; columellar lamella moderately prominent in front view, thin, broad and subhorizontal within. Parietal callus very thin. Length 7, diam. 3.2, aperture 3 mm.; 6 whorls.

Molokai: near the top of Mauna Loa, at about 1350 ft. elevation, with *L. dormitor*. Holocene (Cooke and Pilsbry).

Constantly smaller than *L. dormitor*, with only a very thin parietal callus. The shape also differs somewhat and the columella is more thickened, but the shape of the columellar lamella is nearly the same.

L. CORNEOLA (Pfeiffer). Pl. 9, figs. 1, 2.

Vol. XXI, p. 58. Very beautiful specimens, here figured, have been taken by Mr. Thaanum in Halawa. The color of the last whorl is ecru-olive or between that and deep colonial buff, becoming chamois on the spire. Some shells have a narrow subsutural line of chestnut. Two of this lot are figured.

L. OPIPARA MANANA P. & C., n. subsp.

Surface rather strongly, *regularly striate*; whorls 5½; outer lip very slightly arched forward in the middle; columellar fold strong, subhorizontal. Length 10, diam. 4.7, aperture 4.1 mm.

North side of the summit of the peak at intersection of the Waimano-Manana ridge and the main range, Spalding and Pilsbry. Type 108057 A. N. S. P.

L. EMERITA Sykes. Vol. XXI, p. 31.

This widely spread shell occurs as far west as Puunea near Meyer's lake (Cooke and Pilsbry, 1913).

L. CONCOLOR Cooke. Vol. XXI, p. 31.

Common in Kamalo, northwestern ravines; also ravine east of Puu Kolekole, and another east of Makolelau house (Cooke & Pilsbry, 1913).

L. MCGREGORI P. & C., n. sp. Pl. 11, fig. 8.

The shell is imperforate, ovate and obese, the diameter more than half the length; rather thin, glossy, weakly striate, isabella color, somewhat transparent. Summit obtuse, spire conic above, convexly conic below; last whorl large, oval. The suture appears narrowly margined, by transparence. The aperture is rather narrow fully half the length of the shell, vertical. Outer lip smooth-edged but not thickened. Columellar lamella median, thin but strongly developed. No perceptible parietal callus. Length 6.3, diam. 3.7, aperture 3.2 mm.; 5½ whorls.

West Maui: near Lahaina, at 1000 ft. elevation (R. C. McGregor, 1900). Type no. 110592 A. N. S. P., cotype in Bishop Mus.

This is perhaps the most obese species of the genus. It is probably related to *L. guttula* (Gld.), a decidedly larger shell. *L. compacta* Pse. is evidently different. *L. nitida occidentalis* is a much larger shell.

Section ANGULIDENS Pilsbry & Cooke, n. sect.

Shell ovate-conic or cylindric-conic, having the face of the columella and the edge of the parietal callus thickened, the latter *terminating in a callous tubercle which is separated from the termination of the outer lip by a narrow gutter*; aperture contracted. In known species the axis is perforate. Type *L. subcylindracea* Cooke.

Distribution, all of the islands except Niihau and Lanai, (the fossils of which are unknown). With one exception, all of the species are Pleistocene fossils.

This is clearly a natural group, distinguished by a peculiarity found in no other Achatinellid shell. It is of interest to the zoogeographer because the group is common to the Pleistocene deposits of most of the islands, and is thus another proof that the island faunas of Pleistocene time were more closely related than the recent faunas. Most other groups of *Leptachatina* are not characteristic enough in structure to demonstrate the relationships of species from different islands.

The only living species of *Angulidens* are *L. hyperodon* of Maui and *L. microdon* of Waianae. The following six species are now known to belong to the group.

L. FOSSILIS Cooke. Vol. XXI, p. 61. Kauai.

L. COOKEI Pilsbry. Pl. 11, figs. 1, 2.

The shell is perforate, ovate-conic, weakly marked with growth-lines, or nearly smooth and glossy in the best preserved specimens. Apex small, obtuse. Spire straightly conic above, convex below, the last whorl more or less noticeably cylindric, more flattened than the penultimate whorl; the base is convex, compressed around the axial crevice. Whorls 6½, slowly enlarging, the penultimate somewhat convex, those above nearly flat. The suture is superficial; in the last third it ascends slightly, and at the aperture it is rather abruptly, arcuately deflexed. The aperture is oblique, ovate, contracted; outer lip obtuse; columellar lip reflected, thickened on the face, and appressed above the narrow perforation, continuous with a callous cord which bounds the rather thick parietal callus, and terminates in an enlargement or tubercle which is separated from the termination of the outer lip by a narrow groove or posterior commissure of the aperture. The columellar lamella is thin, broad and subhorizontal; outwardly emerging to the edge of the columella.

Length 10, diam. 5, aperture 4 mm.; 6½ whorls.

Length 9.5, diam. 4.9 mm.

Length 9.3, diam. 5 mm.

Length 9.2, diam. 4.4 mm.

Oahu: Kawaihapai, on a steep wooded bluff, about 500 ft. above the coastal plain, and perhaps ¾ mile from the sea. Cotypes No. 110593 A. N. S. P. and in Bishop Mus., coll. by Cooke and Pilsbry, 1913.

Leptachatina cookei PILS., Nautilus, xxviii, p. 61, October, 1914.

This is a much larger, more robust species than other forms having a parietal callus and posterior commissure, and the columellar lamella is broader and less oblique. By its form and texture it recalls *L. resinula.*

No living shells were found, but the species cannot have been long extinct. It may possibly turn up alive in some part of the western end of the Waianae range.

L. MICRODON P. & C., n. sp. Pl. 9, fig. 3.

The shell is perforate, oblong-conic, opaque, light brown; surface rather glossy, marked with fine growth-lines. Outlines of the spire straight in the upper half, where the whorls are but slightly convex; the penultimate whorl more convex; last whorl not very convex, compressed around the axial crevice. Whorls 6⅓. The suture is but slightly impressed, and in the last third of a whorl it ascends slightly, but it is not deflexed at the aperture, as usual in related species. The aperture is hardly oblique, ovate-piriform. The outer lip is obtuse, whitish within. The face of the columella is strongly calloused above, where it passes into the parietal callus. Columellar fold is rather small and ascends obliquely. The parietal callus is thin, transparent, bounded by a thickened edge, which terminates above in a small, drop-like tubercle, separated from the termination of the outer lip by a narrow groove.

Length 11.3, diam. 5 mm.; aperture 5 mm.

Oahu: western ridge of Popouwela, Waianae Mountains, Spalding, Cooke and Pilsbry, 1913.

L. cookei is a shorter shell with more conic spire; the aperture is contracted; the columella is notably shorter, with a

stronger fold, and the parietal callus is much heavier. The type lot was found just west of the crest of the ridge, some distance north of the "Endodonta locality", on the steep, shaded and leafy slope. So far as we know, it has not been found elsewhere.

L. SUBCYLINDRACEA Cooke. Pl. 11, figs. 10 to 14.

Vol. XXI, p. 28, pl. 3, fig. 59. The type of this species, no. 57820 A. N. S. P., was found in a lot of *L. oryza* received from Dr. Newcomb. It has the same texture and bluish-white color as the associated *oryza*, and very likely came from one of the roadside deposits in the region of Kahuku. One from there is figured, pl. 11, fig. 10.

The shell is solid and perforate. The surface is finely, somewhat irregularly striate, the striæ stronger and curving backward near the suture. There is a broad margin visible by translucence below the suture, but not otherwise defined. The columellar lamella is small and deeply immersed. The thick reflection of the columellar lip almost closes the perforation. The parietal callus is thick and terminates above in a small tubercle, separated by a narrow channel from the termination of the outer lip. Length 6.8, diam. 2.8 mm.; 6½ whorls.

When only a few specimens of this species were known, it was not unnaturally thought to be a form of *L. oryza*. Now that hundreds of specimens have been found, it is easy to see that it belongs to the group of *L. fossilis* of Kauai, having the same peculiar parietal callus and posterior gutter. The description is amplified above, from the type specimen.

Oahu, in Pleistocene deposits: Punchbowl, about 300 ft. below summit (Wm. Alanson Bryan); Diamond Head, on the n.-w. and ocean sides, and within the crater; also in the supposed raised reef, eastward (Cooke and Pilsbry). Coral bluff near Kahuku (C. & P.).

Molokai: Sand dunes of Moomomi, also near the summit of Mauna Loa, at about 1350 ft. under stones, Holocene (Pilsbry & Cooke).

Kahoolawe: Pleistocene deposits of "Schooner Bay," on

the Maui side (Cooke & Pilsbry). Smuggler's Bay, on the south side (Pilsbry).

In shells from Diamond Head and Punchbowl the surface is almost smooth, and the columellar lamella is often, but not always, stronger than at Kahuku. Diamond Head specimens vary in size from length 6.25, diam. 2.8 mm., to length 7.8, diam. 3 to 3.1 mm.

The shells from Moomomi, Molokai, pl. 11, fig. 14, do not seem to differ from the types in striation, but the columellar lamella is perceptibly stronger, as in shells from Diamond Head. It is an abundant species in the dune deposits and on the bluff up to about 600 ft.; also in the reddish earth of the buried forest-layer.

Specimens measure:

Length 7.7, diam. 3.1, aperture 2.8 mm.; 6¾ whorls.

Length 7.3, diam. 3.1, mm.

Length 6, diam. 2.8 mm. (smallest one noticed).

On the south side of the "crater" near the treeless summit of Mauna Loa, specimens were found under the stones of aboriginal sweet-potato hills. The shells are fragile from decay and are very small, 5.8 mm. long, 2.5 wide, to 5 mm. long, 2.3 wide; 5½ whorls. Probably the summit of Mauna Loa was the last stand of land shells in the western half of Molokai; and it seems likely that data fixing the date of last occupation of the peak could be recovered from old natives of Molokai. It is clear that up to that time, *Partulina, Amastra* and *Leptachatina,* as well as the smaller snails of other families, still existed there.

Kahoolawe specimens, pl. 11, figs. 11, 12, 13, are slightly differentiated by their more regular and close striation, and it might not be amiss to distinguish them as a local race. They are usually 7 to 8 mm. long.

L. subcylindracea is a more slender and elongate shell than *L. hyperodon* and *L. anceyana.* It is also more solid, with the parietal callus better developed.

L. HYPERODON, n. sp. Pl. 11, figs. 6, 7.

The shell is perforate, oblong-conic, grayish yellow, a little

translucent, faintly striate. Outlines of the spire are convex below, straight near the obtuse, rounded apex. The whorls are barely convex, the last ascending a little towards the aperture, where the suture abruptly turns down. The aperture is vertical, narrowly rounded but scarcely angular at the foot of the columella. Outer lip obtuse, contracting a little, columella vertical, reflected, passing into the parietal callus, which is distinctly if but slightly thickened near the edge, and forms an oblong, small tooth where it terminates at the posterior commissure. The columellar lamella is scarcely or not visible in a front view, but is moderately strong and oblique in an oblique view in the aperture. Length 5.8, diam. 2.75, length of aperture 2.7 mm.; 5½ whorls.

East Maui (Newcomb). Type and another in the Newcomb collection, Cornell University.

This species differs from *L. anceyana* Cooke (a fossil of the Mana deposits, Hawaii, Vol. XXI, p. 39) in very little besides its smoother surface. The Hawaiian shell is rather strongly striate, the striæ becoming stronger and recurved near the suture. The difference in sculpture between the two forms is emphasized by the whiteness of the fossil, which gives the striation full value to the eye. If found on the same island, we would rank *hyperodon* as a variety of *L. anceyana*.

Newcomb's collection contains two species in the vial labeled *A. grana* (no. 29981 of his collection in Cornell University). Four shells are the form figured as *grana* in Vol. XXI. Two belong to the species described above.

L. ANCEYANA Cooke. Vol. XXI, p. 39.

To the description of *anceyana* should be added: The parietal callus is slightly thickened along its outer edge, and enlarges into a small, somewhat triangular tubercle posteriorly, separated from the termination of the outer lip by a narrow channel.

Section LABIELLA Pfr.

L. LABIATA (Nc.). Vol. XXI, p. 77. Additional localities are Mokuleia (Gulick), Popouwela (Pilsbry, Spalding and

Cooke). It extends the whole length of the Waianae range, on ridges of the northern side.

Section Ilikala Cooke.

L. petila (Guliek). Pl. 9, figs. 5, 6, 7, 8.

Vol. XXI, p. 92, pl. 11, fig. 9. In the type lot from Koko Head the color is pale yellowish brown (cinnamon-buff). Surface dull. First whorl smooth, the next with fine, close axial striæ. The later whorls have *thread-like striæ, unequal and unevenly spaced*, but fine and close. The outer lip is obtuse. Columellar fold small and strongly oblique, *hardly visible in a front view*. Parietal callus noticeably thickened at the edge. Length 6.6 to 6.8 mm.

Oahu: Koko and Keawaawa (Guliek). Fossil at Kaelepulu, Kailua, in pockets of a calcareous sand-rock bluff, about ¼ mile from the sea (Pilsbry).

The specimens from Keawaawa (pl. 9, figs. 7, 8) are like the types from Koko. In the fossil deposit on the Kailua peneplain the shells are a trifle larger, up to 7.2 mm. long, and the columellar lamella is obsolete, represented by a slight swelling only (pl. 9, figs. 5, 6). The striæ are unequal, and usually in groups.

L. petila is a dry-country species, very likely derived from the following humid zone form. It belongs to the rapidly disappearing low country fauna.

L. nematoglypta Pilsbry & Cooke, n. sp. Pl. 9, figs. 9, 10.

The shell is narrowly perforate, turrite, rather thin, chestnut brown or auburn. First whorl smooth, the next very delicately striate axially. Later whorls have thread-like striæ, unequal and unevenly spaced, often twinned or in groups of three. The whorls are strongly convex and parted by a well impressed suture. Outer lip thin. Columella distinctly truncate in a front view, having a strongly oblique but rather small lamella. Parietal callus very thin. Length 8.7, diam. 4 mm.; aperture 3.25 mm.; 7 whorls.

Oahu: Kawailoa (Guliek); Halawa (Thaanum, type loc.);

fossil in Nuuanu and Manoa valleys (Cooke), and 1½ miles west of Kahuku (Pilsbry & Cooke).

L. petila, specimens from Nuuanu and Manoa, Vol. XXI, p. 92, pl. 4, f. 61-63 (Manoa), 64 (Nuuanu).

This is larger and much darker colored than true *L. petila*, and has a decidedly stronger columellar lamella. The outer lip is thin, and the parietal callus merely a film. It is a shell of the humid zone, which has not yet been found living east of Halawa. The fossil material from Nuuanu and Manoa, figured in Vol. XXI, seems to belong to this rather than to the real *L. petila*.

Mr. Gulick had one specimen from Kawailoa, now no. 1239½ Boston Society collection; and there was one specimen in the lot of fossils (Pleistocene or later) which we took on the "coral bluff," 1½ miles west of Kahuku.

Genus PAUAHIA Cooke.

Vol. XXI, p. 80. Type *P. artata*.

As genera go in *Achatinellidæ*, this group we think should have generic rank. It differs from *Leptachatina* by the closely coiled whorls and the development of internal lamellæ —a strong columellar lamella which is broad and flares upwards in the penultimate whorl, diminishing in those above and below, and a palatal lamina subperipheral in position, about half a whorl long, in the penultimate and part of the last whorl. In some species, as *P. chrysallis*, both are absorbed in the adult stage; in others (*P. tantilla*) they persist. Both lamellæ appear very early, being present before the shell has attained three whorls (pl. 14, fig. 1, *P. tantilla*, length 1.6 mm.). The soft anatomy is unknown except the teeth.

P. tantilla Cooke (Vol. XXI, p. 81) is found on the western ridge of Popouwela in the "*Endodonta* locality" (Spalding, Pilsbry and Cooke). An infant of this lot is figured, pl. 14, fig. 1.

P. chrysallis (Pfr.) has an internal axial lamella, double at the edge, and a palatal lamina, in shells 8 mm. long, from Kawailoa, coll. by Gulick. Adult shells of the same lot opened

have the axis simple above the last whorl, the internal processes being absorbed. This species was found by us also on the western ridge of Popouwela, in the Waianae mountains, together with *P. tantilla.*

P. (?) SEMICOSTATA (Pfeiffer). Pl. 9, fig. 12.

Vol. XXI, p. 65. The numerous, closely coiled whorls, the short last whorl and narrow mouth, give reason for believing this species will turn out to belong to *Pauahia.* We cannot find a satisfactory place for it in any other group of *Leptachatina.* The figure was prepared under the eye of Mr. E. A. Smith, and represents the type-specimen in the British Museum. It has not been figured before, and has not been rediscovered by Hawaiian conchologists.

Sub-family AMASTRINÆ.

Genus CARELIA Ads.

Carelia adusta in both plain and bicolored forms is in Mr. Joseph Emerson's collection from Haena. *C. cumingiana* in the same collection is labeled as from the koolau or northern district of Kauai.

C. OLIVACEA Pease. Pl. 9, figs. 11, 15.

Vol. XXI, p. 106. Specimens in the Pease collection, no. 23343 Mus. Comp. Zoology, are here figured. The larger one is not the type of *olivacea,* which was still larger. The smaller may be the type of Pease's var. *viridis.* Both are "dead" shells which have lost nearly all of the periostracum. The aperture is narrower and longer than in *C. hyattiana,* and the columella is *much more deeply arched.* The outlines of the spire are more convex, and the last whorl is less angular.

Length 52, diam. 17.25 mm.; 8 whorls.

Length 42, diam. 15 mm.; 7½ whorls.

Genus PTERODISCUS Pilsbry.

Vol. XXI, p. 118. Snails of this genus live on sticks and dead leaves, on steep, moist, well-shaded slopes. They are very hard to find, the irregular shape and dark color of the

dirt-loaded shell assimilating well with their surroundings. They are widely spread, and probably to be found with careful search wherever conditions are suitable. As in the typical group of *Endodonta*, the colonies are isolated and probably small, though we suppose neither so small or so widely separated as the colonies of *Endodonta* appear to be. The incrusting dirt is, of course, foreign to the shell, to which it adheres quite firmly, being cemented thereto by the slime of the animal. *Pterodiscus* is colloquially known in the Islands as "Flatamastra."

Having seen a good many specimens we are disposed to agree with Mr. Spalding that too many Oahuan forms have been described. They are rather variable in degree of depression, carination, width of umbilicus, and of course in the amount of dirt carried. I had not time to go over Mr. Spalding's long series except in the most superficial way, but a re-examination of the Academy's series, augmented by seven lots from as many localities, which I brought home, indicate two species in each Oahuan range.

1. Umbilicus narrower, often closed with agglutinated material; columellar lamella well developed: P. REX Sykes, including *P. thaanumi* and *P. cookei*. Eastern in the Main Range.

2. Umbilicus wider, broadly conic, with angular margin; columellar lamella smaller, receding: P. WESLEYI Sykes. Western in the Main Range.

3. Umbilicus narrow, columellar lamella well developed, spire flat: P. DISCUS P. & V. Waianae Range.

4. More elevated and solid, etc.: P. HELICIFORMIS Anc. Waianae Range.

P. heliciformis, hitherto reported merely from the "Waianae Range," has been found in some quantity in Palikea (Thaanum). The specimens are somewhat smaller than the types, and like them vary in elevation and size of the umbilicus. Some of them, chiefly the young ones, are conspurcate, especially at the periphery.

Genus AMASTRA Adams.

A. (KAUAIA) KAUAIENSIS (Newe.). Vol. XXI, p. 143.

In Mr. Joseph Emerson's collection there is a series of 28 specimens of this rare species taken in Little Norway, Halemanu.

Subgenus CYCLAMASTRA Pils.

Vol. XXI, p. 147. By its perforate axis and convex, unspecialized embryonic whorls, *Cyclamastra* is the most primitive of existing *Amastrinæ*. It is now known to be found on all the islands except Lanai, the fossils of which have not been collected. It is most frequently encountered as a fossil of the land-shell beds. Formerly widely spread and wonderfully abundant, it is now local, and except in a few localities, rare.

Series of A. sphærica.

A. OBESA AURORA P. & C., n. subsp. Pl. 4, figs. 9, 10, 11, 12.

The shell resembles typical *A. obesa* in shape and surface, but differs by having a red lip-rib, and the embryonic shell (fig. 11) is less acutely angular at the periphery than in *obesa* (*cf.* pl. 4, fig. 13, embryo of *A. obesa* from Polipoli Forest Reserve).

Length 10.5, diam. 8 mm.; 5½ whorls.

Length 10, diam. 7 mm.; 5⅓ whorls.

Length 9.6, diam. 8 mm.; 5⅓ whorls.

Length 8.2, diam. 6.7 mm.; 5 whorls.

East Maui: Auwahi, at about 4200 ft. elevation, (D. Thaanum, 1913). Cotypes in collections of A. N. S., Bishop Mus. and Thaanum.

Mr. Thaanum reports that this race was found in large numbers in open forest, on dead leaves, among and under rocks. Nearly all adult shells are free from dirt. The young ones are sometimes bedaubed, the agglutinations usually most copious at the periphery. The reddish color of the lip-rib is constant, only varying in intensity. It fades in alcohol.

In the same neighborhood and at almost the same elevation,

a very pretty small form of the race was found. It was from more open country, at the upper edge of the forest.

Length 9, diam. 7 mm.; 5⅓ whorls (largest).

Length 8, diam. 6 mm.; 5 whorls.

Auwahi is two miles or a little more from Polipoli, a grassy ridge separating the two localities, which are on the great ridge running southwest from Haleakala.

A. obesa of normal size, with the aperture white, was taken by Mr. Thaanum in the Polipoli Forest Reserve, Kula, at 4300 ft. elevation. It is very rare there, only about a dozen living shells found in two days. They measure from length 11.5, diam. 9mm. to 11 x 8⅓ mm. Even the living ones have the cuticle partially deciduous. An embryo is figured, pl. 4, fig. 13.

A. METAMORPHA P. & C., n. sp. Pl. 5, figs. 1 to 5.

The shell is perforate, dextral, long conic, rather thin; russet, the last whorl usually light brownish olive or isabella color, and white under the cuticle in adults. Spire straightly conic, the whorls convex. Embryonic whorls convex, worn in adults, but in the young they are very minutely and delicately striate (fig. 5). Later whorls are lusterless, with sculpture of indistinct, irregular growth-lines, the last whorl usually having a few coarse wrinkles. The aperture is small, with a rather thick white lining in adult shells; outer lip acute, dark-edged, not thickened within. Columellar lamella small and oblique.

Length 12.25, diam. 6, aperture 5 mm.; 6½ whorls.

Length 11.25, diam. 5.5, aperture 4.7 mm.; 6 whorls.

Length 10.5, diam. 6.3, aperture 4.9 mm.; 5¾ whorls.

West Maui: Olowalu Gulch, D. Thaanum. Cotypes in A. N. S. P. and Bishop Mus., also in Thaanum coll.

This interesting Amastra was found by Mr. Thaanum in July, 1913. It is isolated among Mauian species, and appears to be an elongated form of *Cyclamastra*, related remotely to *obesa* and *agglutinans*. There is a certain resemblance to the Hawaiian group of *A. melanosis*, which like *A. metamorpha* has affinities with both *Amastrella* and *Cyclamastra*.

The rough surface, white lining, embryonic sculpture, and the mode of agglutination, are all features which we think indicate relationship to *A. obesa.*

So far as known, Cyclamastras of the *umbilicata* series do not agglutinate; but as nearly all of them are fossils, this point is somewhat uncertain. At all events, the Mauian *A. morticina* differs from *A. metamorpha* by its more ample umbilicus, the conspicuous angularity of the aperture at the foot of the columella, and by its stouter figure.

Most adult shells are clean, but the immature stage is sometimes copiously loaded with dirt, the thickest accumulations being at the periphery and around the lip. See figures 3 and 4.

A. METAMORPHA DEBILIS P. & C., n. subsp. Pl. 5, figs. 6, 7.

Differs from the preceding by the *absence of any white lining of the interior,* the shell being very thin, even fragile. Exterior russet throughout. Columellar lamella smaller and more oblique. Average contour more slender than in *metamorpha.*

Length 13.1, diam. 5.8 mm.; 6½ whorls.

Length 12.1, diam. 5.7 mm.; 6⅓ whorls.

Length 11.5, diam. 5.25 mm.

Olowalu Gulch, at a greater elevation than *A. metamorpha,* D. Thaanum, July, 1913.

This may prove specifically distinct, if intergrades with *metamorpha* do not turn up; yet the general resemblance of the two forms is such that they may well be associated for the present.

Series of A. umbilicata.

For the greater part, these were shells of the plains and low elevations, down to near sea level. With the passing of the low forests these Amastras have become extinct, with few exceptions.

A. HARTMANI 'Newc.' Hartman. Pl. 2, figs. 19, 20.

Vol. XXI, p. 160. Specimens in the Newcomb collection,

here figured, serve to elucidate this little-known form. They have the whiteness and texture of sand-dune fossils. It appears that Doctor Newcomb had a tablet bearing five specimens. Three remained glued fast when one of us examined it. Two shells had been removed, as the glue marks show, and doubtless were given to Doctor Hartman. The label on the tablet is as follows: "Achatinella Hartmani Newcomb. extincta Pfr., a misnomer as this is not an extinct species. Kauai."

It appears therefore that the locality given by Hartman "Oahu" was from Pfeiffer, who gave that locality for *A. extincta*, which Newcomb and Hartman supposed to be the same as *hartmani*. Newcomb's "recent examples," thought to be the same as these fossils, but really differing by the far less inflated shell, were said to be from Oahu. Stripped of the masque fashioned out of the misconceptions of Newcomb and Hartman, it appears that *A. hartmani is a fossil shell of Kauai, closely related to* A. similaris *Pse., and so far as we know, unlike any Oahuan species.*

A. hartmani has a conspicuously rotund last whorl and a straightly conic spire. The whorls are strongly convex, suture deeply impressed, by transparence showing a very narrow clear gray margin below. There are irregular and rather strong wrinkles of growth on the last whorl. The surface is glossy, perhaps polished by the dune sand. Outer lip is obtuse, somewhat thickened within. Columellar fold small, as in *A. similaris*. The only difference between these shells and *A. similaris* received from Pease is that the aperture is a little more rounded at the base of the columella in *A. hartmani*. In *similaris* it is more distinctly angular. The value of this difference remains to be seen, when the shells are collected in quantity. Fossil Cyclamastras are generally found in copious numbers. Meantime *A. hartmani* may be given a provisional place in the Kauaian list.

Length 12.3, diam. 7.9 and 8, aperture 6.1 mm.

Length 12, diam. 7.5, aperture 6.1 mm.

The tip of the spire is broken in all of the shells.

A. ANTIQUA KAWAIHAPAIENSIS P. & C., n. subsp. Pl. 2, fig. 13.

Differs from *A. antiqua* Bald. (Vol. XXI, p. 160), by having the spire straightly conic, not contracted near the summit; last whorl somewhat swollen above the periphery, while *antiqua* is evenly convex; sculpture much less coarse. It is found in the soil of a plowed field between the bluff and the railroad, and though fossil, shows some color. The embryonic whorls are neutral red, gradually fading downwards, the last two whorls gray-white. The surface is weakly and very sparsely plicate, and irregularly indented. Aperture small, contracted, subangular at base of the columella. Peristome acute, strengthened with a rather strong orange-cinnamon callus which is somewhat further from the edge than usual. Columellar lamella rather small. Umbilicus about as in *A. antiqua* or slightly more compressed. Length 17, diam. 10.5, aperture 8.3 mm.; 6 whorls.

Oahu: Kawaihapai, at the western end of the Waianæ Mountains, in soil of a field, perhaps 20-30 ft. above sea level, Pilsbry and Cooke, 1913.

A. UMBILICATA (Pfr.). Pl. 2, figs. 5 to 8.

Vol. XXI, p. 251. This species was sent to Pfeiffer by Frick. In the absence of Oahuan specimens, I formerly followed Newcomb's identification of Molokaian specimens as *A. umbilicata,* and doubted its occurrence on Oahu. Specimens agreeing fully with Pfeiffer's description and with Newcomb's Molokai examples are now before us from the following places in Oahu:

1½ miles east of Kahuku; Laie, west of the stream, between the road and the sea (Cooke and Pilsbry); Kaelepulu, Kailua, in debris of a rocky bluff 6 to 10 ft. high, about ¼ mile from the sea (Pilsbry). All of these specimens are from Pleistocene deposits not far above sea-level.

We know from the shells he got that Frick collected a good deal on the koolau side of the Main Range, and he certainly must many a time have passed the Laie and Kahuku deposits within a few feet, on the shore road. We do not doubt, therefore, that the type of *A. umbilicata* came from Oahu,

and from this region; and would suggest that the Kahuku deposit be considered type locality. The species was doubtless once spread along the whole north shore.

Many Kahuku shells (pl. 2, figs. 5 to 8) retain the color, orange-cinnamon above, fading to cinnamon-buff on the last whorl, or only the spire or the summit may be tinted, or the whole shell bleached white. The lip is blunt in adult shells. The columellar lamella is moderately strong, and does not quite reach the edge of the columellar lip. The latter is straightened, with a basal sinus which is filled up in old shells.

Length 11.5, diam. 6.2 mm.; 6 whorls.

Length 10.25, diam. 6 mm.

Length 11.3, diam. 6 mm.

Length 9.6, diam. 6 mm.

The last measurement is that of a scarcely adult shell, the broadest of a considerable series.

Specimens from Laie and Kailua are similar, but have lost all color.

The exact locality in Molokai where Dr. Newcomb obtained living *umbilicata* is not known. In one of the lots sent to the Academy it was mixed with *petricola*. So far as we know, neither species has been found by recent collectors on that island. We can find nothing in the shells to separate Newcomb's specimens from those of Oahu, but the fossil form from Molokai seems somewhat different.

A. UMBILICATA ARENARUM P. & C., n. subsp. Pl. 2, figs. 1 to 4.

The shell is decidedly larger than *umbilicata*. It differs from *morticina* by having the spire more slender at first, then rather rapidly widening.

a. Length 14, diam. 7.5, aperture 6.25 mm.; 6⅔ whorls.

a. Length 13, diam. 6.3, aperture 5.3 mm.; 7 whorls.

b. Length 14, diam. 7.75, aperture 6.5 mm.; 6½ whorls.

b. Length 14.75, diam. 7.1, aperture 6.1 mm.; 6¾ whorls.

b. Length 12.3, diam. 7.2, aperture 6 mm.; 6½ whorls.

c. Length 11, diam. 6.5 mm.

c. Length 12, diam. 7 mm.

Molokai: Pleistocene sand dunes of Moomomi, Cooke and Pilsbry, 1913. Cotypes in A. N. S. P. and Bishop Mus.

The measurements are from specimens from about 600 ft. elevation, at top of the bluff, *a*; dunes at base of the bluff, *b*; and low ground behind the dunes, about ¾ mile south of the beach, *c*, where they average slightly smaller. Figures 3, 4, are normal, average specimens; figs. 1, 2, are selected slender and obese shells. A few of the best-preserved shells have the summit tinted pinkish-cinnamon.

A. u. arenarum is excessively abundant in the deposits.

A. FRAGILIS Pilsbry & Cooke, n. sp. Pl. 2, figs. 11, 12.

The shell is *thin, fragile*, perforate, narrowly ovate-conic, chestnut brown, scarcely shining, very finely, irregularly striate, and with larger striæ at irregular intervals; commonly daubed with fæcal matter and soil. Summit rather obtuse; whorls convex, the last obtusely angular around the narrow umbilical slit. The aperture is oval, angular at both ends. Outer lip thin and fragile; columellar lip thin, straightened. Columellar lamella small, thin and very oblique, not quite reaching the edge.

Length 9, diam. 4.7, aperture 4 mm. 5½ whorls.

Molokai: Pipe-line trail in upper Kaunakakai, above and below the spring (Cooke and Pilsbry, Jan. 26, 1913), cotypes no. 108629 A. N. S. P. and in Bishop Mus. Kalamaula (Thaanum). Northwestern ravine of Kamalo, above the old ditch trail; also further east, near the western *Partulina redfieldi* colony (Pilsbry and Cooke). Waikolu gulch (Thaanum).

The obtuse but noticeable angulation around the umbilicus, and the shape of the aperture indicate that this is a narrowly umbilicate species of *Cyclamastra,* distinguished from the immediate allies of *A. umbilicata* by its more slender contour, excessively thin shell and narrow umbilicus. In common with some of its allies, it carries more or less dirt on the shell.

The form taken in Kalamaula by Mr. Thaanum, pl. 2, fig. 12, is stouter in figure, but otherwise like the types. One measures, length 8.5, diam. 5, aperture 4 mm., with 5 whorls. An

oblique view is given to show the steep ascent of the columellar lamella.

The Waikolu specimens approach those from Kalamaula in shape.

A. MORTICINA Pils. Vol. XXI, p. 280.

Differs from *A. umbilicata* by its larger size and slightly more regular increase of the spire, that of *umbilicata* being more attenuated in the upper part. The differences are rather trivial and would be thought unimportant were both forms from one island.. As it is, we are inclined to reduce *morticina* to a subspecies of *A. umbilicata.*

Specimens taken by us in Pleistocene deposits at "Schooner Bay," on the uninhabited desert island of Kahoolawe, are not distinguishable from the types from Maui.

A. ULTIMA Pilsbry & Cooke, n. sp. Pl. 2, figs. 9, 10.

The shell resembles *A. morticina* in figure, but differs by having a noticeably larger umbilicus, and a much weaker columellar lamella. The spire is straightly conic, whorls all convex, those of the embryo smooth, the rest with weak sculpture of uneven and irregular growth-striæ. Color from russet to mars brown. Last whorl is compressed around the umbilicus, within which there is a spiral sulcus opposite the columellar lamella. The aperture is rather narrow, angular at both ends, interior colored like the outside; outer lip thin; columella vertical, bearing a very low and very oblique lamella which does not quite reach the edge.

Length 10, diam. 6.1, aperture 5 mm.; 6 whorls.

Length 9.9, diam. 6, aperture 4.3 mm.; 6 whorls.

Hawaii: Kahuku, Kau, under lava slabs on a nearly naked flow, D. Thaanum. Cotypes 108146 A. N. S. P. and in Bishop Mus.; also in Thaanum coll.

This is a species of the greatest interest, as it adds a member of the ancient group of *Amastra umbilicata* to the fauna of Hawaii, and in a locality near the southern point of the island. This group of very similar forms is now known from end to end of the archipelago, chiefly in deposits of Pleistocene age.

The specimens of *A. ultima* were probably from the lava flow of 1887, which ran through Kahuku.

Section METAMASTRA (Oahu).

A. EOS Pilsbry & Cooke, n. sp. Pl. 2, figs. 14, 15.

The shell is perforate, thin, globose-conic, chestnut brown, darker along the suture, the base paler, marguerite yellow, at least near the axis. Surface slightly lustrous, finely, irregularly striate, without spiral lines. Apical whorls smooth. Outlines of spire straight above, convex below. *Whorls strongly convex immediately below the suture.* Outer lip thin; columellar lamella thin, moderately oblique.

Length 12.4, diam. 8, aperture 6.25 mm., 6 whorls.

Length 12, diam. 8.5 mm.

Oahu: Keawaawa. Cotypes no. 108171 A. N. S. P.; also in coll. Thaanum. Kuliouou, W. D. Wilder.

The living shell has a good deal of adhering dirt. Compared with *A. breviata* Baldwin, of Halawa and westward, this species differs by being thinner, without creamy markings, and especially by being swollen just below the sutures. *A. breviata* is very closely related to the Main Range form of *A. reticulata.*

The division of colors on the last whorl is generally conspicuous and abrupt in immature shells, but in old ones the colors become blended, though the bipartite pattern is visible on close inspection.

A. eos is from the eastern limit of *Amastra* in Oahu. We fancy that the two localities given above really denote the same colony, where Messrs. D. B. Kuhns and W. D. Wilder collected. There has been some uncertainty among collectors as to the limits of the two valleys.

A. TRANSVERSALIS BRYANI n. subsp. Pl. 2, fig. 16.

The shell is perforate, cylindric with conic spire, rather solid. Sculpture of irregular growth-wrinkles which are a little puckered and retractive next the suture, and are *never cut into oblong granules*, or crossed by impressed spiral lines as in *A. transversalis* or *caputadamantis.* The best preserved

shells show numerous tawny spiral lines and bands. Near the summit the outlines of the spire are a trifle concave. Embryonic whorls a little more convex than those following. The aperture is subvertical; outer lip obtuse, thickened. Columella vertical, forming an angle with the basal lip. Columellar lamella strong, subhorizontal.

Length 12.3, diam. 6.7, aperture 5.3 mm.; 6¼ whorls.

Length 12, diam. 6.4, aperture 5.3 mm.

Oahu: Outside of Punchbowl, Honolulu, about 300 ft. below the summit, about 2 ft. below the surface of the soil (Professor Wm. Alanson Bryan, Mar. 15, 1913), type 108958 A. N. S. P.

This subspecies is well distinguished from *A. transversalis* by the sculpture. The latter species invariably has the axial striæ more strongly developed and *cut into granules.* The color pattern also will probably prove quite different, but it is visible on only one of the series taken by Professor Bryan. Some other specimens however, show a tendency to erode in spiral bands, doubtless indicating former color markings.

On Diamond Head we took specimens shaped exactly like the types out of a breccia of hard mud and angular fragments of lava, which forms the left wall of the path up to the lookout, inside the crater. None of them show color-markings. Larger shells, length 13.7, diam. 7.3, aperture 6 mm., with 6⅓ whorls, were taken.

A. vetusta Baldwin, described from Punchbowl (Vol. XXI, p. 178), is a more strongly sculptured shell of different outline. *It is very closely related to A. albolabris,* from which it differs chiefly by the smaller size and more conic shape. By a slip of the pen *A. vetusta* was referred to as "*A. venusta*" in Vol. XXI, p. 163, and on p. 174, tenth line from bottom.

A. caputadamantis is probably to be regarded as a subspecies of *A. transversalis.* It is larger and more cylindric, but has sculpture of the same character.

The group of *Amastra transversalis* requires much further work in the field. They are to be looked for in the superficial deposits of the Pleistocene craters which stand in line along the foothills of Kona.

A. TEXTILIS (Fér.). Vol. XXI, p. 164. *A. cookei*, Vol. XXI, p. 182, is merely a form of *textilis*. One of Pease's specimens of *A. solida* (Mus. Comparative Zoology), is a stunted, thickened *textilis*, but it does not seem to have supplied any part of his diagnosis.

A. SUBROSTRATA (Pfeiffer). Pl. 7, fig. 4.

Vol. XXI, p. 174. A translation of the original description has been given in Vol. XXI. A figure of the type-specimen, obtained for us by Mr. E. A. Smith, is now given. This shows that it is identical with part of the shells in the type lot of *A. solida* Pease, described on p. 178 of Vol. XXI. It will be noted that the descriptions of Pfeiffer and Pease read much the same.

A. subrostrata is closely related to *A. textilis* (Fér.), from which it differs chiefly by the more attenuate spire. The outline is convex below, a little concave above. The embryonic whorls have the fine and rather faint striation of *textilis*. The shell is thicker than in *textilis*. It differs from *A. albolabris* by the texture, sculpture, color and shape of the aperture. *A. æmulator* has very much stronger sculpture on the embryonic whorls, as in *A. cornea*, and belongs to an appreciably different group of species. The deep recess below the columellar lamella and the somewhat straightened basal lip of *A. subrostrata* can be matched in any good series of *A. textilis*.

A. subrostrata has the appearance of a shell from the eastern part of the Main Range.

Two of Pease's specimens of *A. solida* (pl. 7, figs. 2, 3) are identical with *A. subrostrata*. One is Prout's brown, the other russet to cinnamon brown, both indistinctly mottled and streaked with whitish on the last half whorl; embryonic whorls of the same color. In one shell (fig. 3) the lip is subangular outwardly, and has a smooth, rather thick, internal lining. Length 13.5, diam. 7.8 mm., 5¾ whorls. The other has an amorphous, pimply, yellowish lip, which has been built forward from a smooth one, visible about 3 mm. within (fig. 2). The columellar margin and parietal callus

are also strong, yellowish and roughened. It is evidently a very old shell which has added to the peristome in the senile stage, after normal growth had been completed. This specimen supplied part of Pease's description—the phrases "more rarely rounded-angulate at the base" and "Peristome rugose, calloused, the margins joined by a thick callus" applying to it.

A. MONTAGUI Pilsbry. Pl. 5, fig. 13.

The shell is *sinistral*, imperforate, oblong-ovate, rather thin, chestnut-colored, with a denuded ecru-olive patch in front of the aperture and an ill-defined yellowish band below the suture. The very thin cuticle is somewhat dull. Outlines of the spire are somewhat convex, the summit rather obtuse. The whorls are most convex close below the suture. Surface finely sculptured with unequal growth-ripples; embryonic whorls very minutely, indistinctly striate, convex. The aperture is oblique, slate-violet within; outer lip acute, black-edged, with a slightly thickened whitish submargin within. Columellar lamella thin, rather steeply ascending, subtriangular. Length 13, diam. 7.75, aperture 6 mm.; 5½ whorls.

Oahu: Summit of the Main Range, between Waiahole and Waiawa, D. Thaanum. Cotypes no. 108172 A. N. S. P. and 6842 Thaanum coll.

Amastra montagui PILS., Nautilus xxvii, August, 1913, p. 39.

This species, which was named in honor of Doctor C. Montague Cooke, is related to *A. thaanumi*, which was found in Kaaawa, on a lateral spur of the Main Range, some miles north of the habitat of *A. montagui*. The main difference between the species is that *A. montagui* is much more slender.

This is the second sinistral *Amastra* from Oahu. All other sinistral species of the genus belong to the subgenus *Heteramastra*, and live on the islands Molokai, Maui, Lanai and Hawaii.

A. RETICULATA Pfr. Vol. XXI, p. 179.

Typical specimens were taken by Mr. Thaanum in Haleauau, and by Pilsbry at the foot of a small intermediate ridge in Popouwela. In both lots, there were also some subcylindric

shells more like var. *dispersa*. Probably *A. conspersa* is not separable from typical *reticulata*.

A. r. dispersa was taken by Thaanum in Haleauau, up to 19 mm. long, the largest 10.5 mm. in diameter. It is also common on the western ridge of Popouwela where the shells are extraordinarily variable in size, shape and color.

A. RETICULATA VESPERTINA P. & C., n. subsp. Pl. 2, fig. 17.

The shell is small, perforate, oblong-conic or coni-cylindric, irregularly striate, not spirally striate; fossil, but the freshest shells show traces of numerous dark spiral bands. Aperture only slightly oblique, angular at both ends. Outer lip obtuse, somewhat thickened within. Columellar lamella prominent and subhorizontal.

Length 12, diam. 6.5, aperture 5.7 mm.; 5⅔ whorls.

Length 13, diam. 6.9, aperture 6 mm.; 6 whorls.

Oahu: Kawaihapai, in soil of a plowed field between the railroad and the bluff, cotypes no. 108980 A. N. S. P. and in the Bishop Museum. Pilsbry and Cooke, 1913.

This form closely resembles *A. transversalis bryani* of the Punchbowl and Diamond Head. Both seem to be depauperate races, possibly in response to the increasing aridity which finally wrought their destruction. *A. r. vespertina* lived on the coastal plain near the railroad, about a half-mile from the first bluff of the Waianae range. It doubtless dates from the humid stage of the Pleistocene or the early human period, when forest extended down to the present sea level.

A. EXTINCTA (Pfeiffer). Pl. 7, fig. 5.

Vol. XXI, p. 159. A figure of the type in the British Museum is given. It seems to be a species of the *A. cornea* group, and should be looked for in the superficial deposits of Kona. The figure suggests a shell which had succumbed to arid environment.

Section AMASTRELLA. Oahu.

A. RUBENS (Gld.). Vol. XXI, p. 192.

Mokuleia, Halcauau and Makaha (Thaanum). A set from Mt. Kaala has the rich chestnut cuticle almost entire, the

under color of nearly the same shade. They have great superficial resemblance to *A. decorticata,* which does not occur in the Waianæ range.

A. DECORTICATA Gulick.

Vol. XXI, p. 200. The type lot of *A. solida* Pease (Vol. XXI, p. 178), lent by the Museum of Comparative Zoology, proves to comprise three species. One shell is a short form of *A. textilis* with an abnormally thickened outer lip, probably senile or pathologic. Two are identical with *A. subrostrata* Pfr., and have been noticed under that caption; one of them served for Pease's description of the peristome.

The fourth shell, pl. 7, fig. 1, is an *A. decorticata,* with exactly the texture and color of many of Gulick's Kawailoa specimens, but slightly abnormal by having the last two whorls rather tumid just below the suture, as if the spire had been slightly telescoped on the penultimate whorl. Exactly the same appearance is occasionally to be seen in *Amastra, Bulimulus* and other shells of like shape. The color is rather peculiar, kaiser-brown with tawny streaks, fading to yellow below the suture on the last 2½ whorls, and with dull blackish streak behind the outer lip; the upper half of the spire being liver-brown. The outer lip has been broken and repaired, is dark-edged, and thickened a little distance within. Parietal callus moderately thick but transparent and therefore not conspicuous, exactly as in *decorticata.* Length 16, diam. 9 mm.; whorls 6⅓. It is a "dead" but fresh shell.

Pease's description of the external color and dimensions were from this shell, while his description of the aperture was from one of the specimens of *A. subrostrata. A. solida* becomes therefore a synonym of both species.

From the appearance of the four shells assembled by Pease in his lot of *A. solida,* we would say that they were from three localities, and were associated by Pease simply because of the thickened peristome. In three of them the thickening is obviously abnormal; the other shell being a normal *A. subrostrata.* Snails with irregular apertural calluses are

common enough in some island faunas, but are remarkably rare in the Hawaiian group, probably because such structures are generally associated with aridity. In the Hawaiian group arid conditions have come in so suddenly that there has been extinction rather than adaptation of the snail fauna.

A. ELLIPTICA Gulick. Vol. XXI, p. 204.

Occurs in a Pleistocene or later deposit 1½ miles west of Kahuku, in a bluff of calcareous-sand rock, near the seashore road, at a far lower level than the species now lives.

Section PARAMASTRA. Oahu.

A. MICANS (Pfr.). Vol. XXI, p. 210.

Amastra erecta Pease, Vol. XXI, p. 305, of which one of us has recently examined the type in the Pease collection, Museum of Comparative Zoology, is identical with *A. micans* (like pl. 37, figs. 5, 6, of Vol. XXI). It is to be deleted from the list of Mauian species.

Specimens of *A. micans* taken by Mr. Thaanum in Haleauau are bandless, chamois or honey yellow to chestnut, often with a fragmentary darker brown outer cuticle, and measure 15 x 7.5 to 17 x 8 mm. Those from Pukuloa are mostly a little narrower, chestnut-colored with dark blue summit.

On the western ridge of Popouwela we found about half of the shells banded (*frosti* pattern), and very few white under a thin, pale yellow cuticle, the upper part of the spire flesh-colored. *A. frosti* is merely a mutation occurring in some colonies of *micans*, and not a valid species or subspecies.

A. SPIRIZONA (Fér.). Vol. XXI, p. 215.

Add the synonym: *Achatinella boetica* Mighels, Jay's Catalogue Edit. 4, p. 214.

The type locality of *spirizona* was doubtless Helemano or in that immediate neighborhood, and it is therefore exactly equivalent to *A. acuta* Swains. It occurs in hybrid colonies with the pattern called *nigrolabris* Smith.

It is a notable fact that in the Waianae range *spirizona* has a different set of associates. I have not the material to

fully work out the question of its relations with *A. cylindrica*, but the two are certainly near akin. Well north on the western ridge of Popouwela it is found in typical pattern, together with *cylindrica* Nc. There is no evidence that they interbreed, and there are no blends in the series collected by Pilsbry. Further up the ridge, southward, in the place where *Endodonta* is abundant, there are a few *spirizona* associated with many *cylindrica-porphyrea-intermedia*, and a very few specimens with the white suture of *spirizona* and the lighter ground-color and coarse striæ of *porphyrea*.

The type figure of *A. rudis* Pfr. (Vol. XXI, p. 219) is photographically reproduced in fig. 17 of pl. 30, Vol. XXII.

A. CYLINDRICA (Newc.). Pl. 8, figs. 12 to 16.

The series from the western ridge of Popouwela demonstrates that *A. cylindrica* (Vol. XXII, pl. 29, fig. 11, photographic copy of type figure), *A. intermedia* (Vol. XXII, pl. 29, fig. 13, type fig.) and *A. porphyrea* (Vol. XXII, pl. 29, fig. 16, type fig.) live in the same colony, no doubt interbreed, and are fully connected by blends. We unite all under the first name, *A. cylindrica*. The specific identity of these forms has already been recognized by several of the Island conchologists. Newcomb's figures are reproduced in facsimile on pl. 29 of Vol. XXII. As they are somewhat idealized, we are giving views of Popouwela shells also, pl. 8, figs. 12-16.

The outlines of the spire vary in convexity, but are supposed to be always more convex than in *A. spirizona*, which has straight contours. The last whorl at least is coarsely striate. The ground-color varies from nearly white or vinaceous buff to mikado brown, and is either plain or encircled with lines and bands of a darker shade. The black or black-brown cuticle remains in shreds, emphasizing the striation, or in patches; and it is most persistent in the dark-ground shells such as Newcomb figured as *intermedia*. The narrow, well-banded shells are Newcomb's *cylindrica*, the wider more obese ones, banded or not, are his *porphyrea*.

A. variegata Pfr. is closely related to the preceding.

Whether constantly distinct remains to be worked out. No new material bearing on this form was obtained in the expedition of 1913.

Amastræ of Lanai.

A. AUROSTOMA Baldwin. Pl. 8, figs. 9, 10, 11.

Vol. XXI, p. 240. Specimens with the cuticle figured in zigzag stripes were taken by Mr. Thaanum near Kaalele Paaka (main ridge east of Lanaihale). In part of the shells this pattern gives place to uniform black on the last whorl. The under color is pale yellow orange or yellow ocher. The largest shells have the aperture and parietal callus white.

A. MAGNA (Newc.). Vol. XXI, p. 237. The original figure of *A. gigantea* Newc. is reproduced on pl. 29, fig. 17, of Vol. XXII.

Amastræ of Molokai.

See pp. 23, 24 for species of *Cyclamastra*.

A. VIOLACEA (Newc.). Vol. XXI, p. 257. Newcomb's original figure is reproduced photographically on pl. 29, fig. 14, of Vol. XXII.

A. PULLATA Baldwin. Pl. 8, figs. 7, 8.

Vol. XXI, p. 261. To the figures cited in Vol. XXI add pl. 37, fig. 17. New localities are: Puunea, north of Meyer's lake (Cooke & Pilsbry). Kalamaula (Thaanum). Head of Makakupaia gulches (Thaanum). Two specimens from the last locality are figured to show the extremes of shape, the more slender shells running into var. *subnigra*. Pipe-line trail near and at its head, upper Kaunakakai (Cooke & Pilsbry), mostly of the *subnigra* shape, but some shells nearly typical *pullata*; last whorl sometimes variegated, usually deep brown or black.

Var. *umbrosa* was taken by Pilsbry and Cooke in the ravine east of Makolelau house, and in the northwestern ravine of Kamalo, above the old irrigation ditch.

A. MUCRONATA (Newc.) Pl. 3, figs. 1, 2, 3 (Mapulehu).

Vol. XXI, p. 268. See also Vol. XXII, pl. 30, fig. 49, type

fig. (also fig. 18, type fig. of *A. fusiformis* Pfr.). Probably Mapulehu is the type locality of this species. Specimens collected there by Mr. Thaanum are figured on pl. 3, figs. 1-3. It is also type locality of the synonymous *A. simularis*. Mr. Thaanum has collected large series of a somewhat smaller form, length 12½ to 15½ mm., in Mapulehu gulch. The aperture is usually less than half as long as the shell. The cuticle varies from elaborately figured to nearly plain. The ground-color is buff-pink, flesh or cinnamon, generally paler at the base, which may be white. More rarely the whole ground is white. The shell is quite thin.

Further west, in Ualapue, Mr. Thaanum found a somewhat more solid form, with obscurely tessellated or merely streaked cuticle.

Still further west, the color-variety *atroflava* was found by Dr. Cooke and myself in the northwestern ravine of Kamalo, above the ditch trail. The ground is cream or naples yellow, sometimes fleshy at the base, and the markings are mummy brown or blackish. Probably the types were from Kamalo, as figs. 9-12 of pl. 41 resemble these shells. Kamalo and Kawela are the western limits of *mucronata*, in any of its forms.

Eastward of Mapulehu, Mr. Thaanum has collected forms of *mucronata* in Waialua and Moanui valleys on the southeastern coast, and at Manawai opa in the great Halawa valley. The shells from these eastern localities are more obese than those from farther west, and might be segregated as a subspecies perhaps.

In Halawa the ground-color is often very dark, liver brown; but others are pale, marguerite yellow. The markings are typical. Near the mouth of Halawa Mr. Thaanum found fossil specimens, resembling those of Mapulehu in shape.

The several varieties of Ancey and Sykes, noticed in Vol. XXI, are based chiefly upon ground-color, which is extremely variable in any large lot. Mr. Ancey's var. *maura* is typical *simularis*, that is, a form of *mucronata*. Possibly the localities of varieties *roseotincta* and *citrea* could be given by Mr.

Perkins, and if so their identity with either the western or the eastern races could be decided.

The relations of *A. mucronata* with *A. modesta, dimissa nubifera* and *subobscura* require further study with more material than we can command.

A. SYKESI (Vol. XXI, p. 273), of which we have now seen a good many specimens, seems very well distinguished from the preceding by its much more globose shape. The locality is Pali-koi, Halawa.

A. SUBOBSCURA H. & P.

Vol. XXI, p. 276. Ualapue. A smaller form which may be called *A. s. puella* was taken by Mr. Thaanum in Ualapue. Length 9, diam. 5 mm., with 5½ whorls. There is a rather acute peripheral carina on the whorls as far as the middle of the penultimate or farther, but no trace of it appears on the last whorl. It is noticeable above the suture in some specimens, nearly or quite concealed in others more closely coiled. Interior bluish white, with a slight thickening within the dark-edged lip in fully adult shells.

A. KAUNAKAKAIENSIS Pilsbry & Cooke, n. sp. Pl. 3, figs. 8, 9, 10.

The shell is narrowly perforate, oblong-conic, very *thin*. Chestnut brown, nude and glossy in front of the aperture, elsewhere covered with a very thin russet cuticle, which darkens to chestnut and often black on the last half whorl, where it becomes somewhat glossy. Embryonic whorls flattened, carinate and costate; following whorls moderately convex, irregularly striate. Young up to middle of the fifth whorl are acutely angular, but the angle is concealed in adults. Aperture dark within, having no white lining and no lip-rib. The columellar fold is thin, oblique. Columellar margin reflected, nearly closing the perforation.

Length 13, diam. 7.1, aperture 6.2 mm.; 5¾ whorls.

Length 14.2, diam. 7.5 mm., 6 whorls (largest).

Molokai: pipe-line trail in upper Kaunakakai district, above and a short distance below the spring. Pilsbry and Cooke, Jan. 26, 1913.

This is a member of the *mucronata* group, distinguished by the very thin shell and the thin, wholly plain, russet cuticle, which darkens to chestnut on the last whorl. It is a thinner shell than *A. subobscura.*

A. KALAMAULENSIS Pilsbry & Cooke, n. sp. Pl. 3, figs. 4, 5, 6, 7.

The shell is imperforate or nearly so, ovate-conic, very thin, glossy light brownish olive in front of the aperture, elsewhere covered with a thin russet cuticle having darker or blackish streaks on the last whorl, often wholly black in its last half, and usually having a cream-white band at the periphery running a short distance in front of the aperture. The embryonic whorls are flat, carinate and costate, the ribs coarser than in Mapulehu *A. mucronata.* Subsequent whorls somewhat convex, marked with irregular growth-lines. The acutely angular periphery persists upon the penultimate whorl, but it becomes rounded before reaching the last, where the position of the keel is marked by a light band on the ventral side in most individuals. The aperture is dark within, with no white lining. Columellar fold thin. Columellar margin reflected, nearly or entirely closing the perforation.

Length 11.9, diam. 7, aperture 6.2 mm.; 5⅓ whorls.

Molokai: Kalamaula. D. Thaanum. Cotypes no. 108227 A. N. S. P. and Bishop Museum. Also in Thaanum coll.

This shell has the very thin texture of *A. kaunakakaiensis,* from which it differs by the more prolonged carinate stage, the more obese shape and the frequent presence of a whitish band in front of the aperture. It has a thinner prismatic layer than any form of *A. mucronata* or *A. subobscura,* and there is not the least trace of mottling or zigzag figures in the cuticle.

In a few specimens the embryonic whorls are slightly convex, the riblets almost obsolete, and the peripheral keel concealed. I cannot see that the rest of the shell differs. Similar cases of heteromorphic embryos have been noted in a few other Molokaian Amastras. By an error of the artist, figure 4 was grouped with figs. 1-3.

A. HUMILIS MOOMOMIENSIS P. & C., n. subsp. Pl. 7, figs. 9 to 14.

Differs from *A. humilis* chiefly by the much smaller, or often obsolete columellar fold. The shape is usually more slender and elongate.

Length 20.5, diam. 8.3, aperture 7.5 mm., whorls 7½.

Length 21.3, diam. 9 mm.

Length 19.5, diam. 9 mm.

Length 18, diam. 8.8, aperture 6.3 mm.; whorls 7.

Molokai: Pleistocene of the sand dunes of Moomomi, around base of the bluff, Cooke and Pilsbry, 1913. Cotypes no. 110594 A. N. S. P. and in Bishop Mus.

These shells dot the sand in the "draws" or swales of the dunes. In many places they may be scooped up by thousands. The loose ones are mostly etched by the blowing sand, but where the red-earth is exposed they occur imbedded, and show the irregular striation of recent *humilis*. The various stages in decadence of the columellar lamella are shown in the figures. Occasionally the surface is somewhat malleate, and in some shells a tawny stain at the summit tells of the dark apex of the living shell.

Moomomi is a shallow bay on the north coast at the end of the great escarpment running north from Mauna Loa. In some places the calcareous sand has been consolidated and stands in cliffs, carved into shelves and points by the wind. The soft layers in this formation are good collecting places for the small and minute forms. The shell-bearing layers begin about 20 ft. above sea level, and run up to about 600 ft.

The presence of great numbers of fragile shells, *Succinea, Endodonta, Philonesia, Tornatellinidæ* and *Pupillidæ* show that the snails were buried where they lived. They indicate decidedly humid conditions and the presence of forest. Such conditions are now found eastward a third of the island's length from Moomomi, at elevations of over 1000 ft., but at present nowhere in the western half of the island. Here, as in Kahoolawe and Oahu, there is conclusive evidence of a Pleistocene climate far more humid than that of today.

Living *A. humilis* was taken by Dr. Cooke and myself in a ravine east of Makolelau house.

A. HUMILIS SEPULTA P. & C., n. subsp. Pl. 7, figs. 15, 16, 17.

Smaller and especially narrower than other forms of *humilis*; columellar fold strongly developed, a second low fold occasionally present above the columellar fold (fig. 15). Aperture small.

Length 17, diam. 7, aperture 6.5 mm.; 7½ whorls.

Length 15.5, diam. 6.5, aperture 6 mm.; 7 whorls.

Molokai: Moomomi, with the preceding. Cotypes 110595 A. N. S. P. and in Bishop Museum.

This is much less abundant than *A. h. moomomiensis* in the series taken, but it was not noticed in the field, where the ground was gone over hastily. It may be that all of them are from some particular bed. It is a point to be worked out when these extensive beds can be gone over in detail.

A. NUBILOSA GEORGII, n. sp. Pl. 7, figs. 6, 7, 8.

The shell is larger than *A. nubilosa*, more slender than *A. n. macerata*. Surface rather coarsely striate and conspicuously malleate when not worn. Columellar fold smaller than in the recent forms, often very small.

Length 26, diam. 12.8, aperture 11 mm.; 8 whorls.

Length 23.5, diam. 12, aperture 10.2 mm.; 7 whorls.

Molokai: Pleistocene, in sand dunes at base of the bluff, Moomomi, Cooke & Pilsbry, Jan. 30, 1913. Cotypes no. 109971 A. N. S. Phila. and in Bishop Museum.

This *Amastra* is rather rare in the dune deposits, associated with *A. humilis moomomiensis*, *Partulina dwighti occidentalis* and many smaller species. Named for Mr. George C. Cooke, manager of the Molokai Ranch.

Living *A. nubilosa* was taken by Dr. Cooke and myself north of Meyer's place, in Puunea, probably the extreme western limit of its range, and the nearest approach of the living form to the locality of the fossil race of Moomomi.

A. TRICINCTA Pilsbry. Pl. 3, fig. 14 (embryo).

Vol. XXI, p. 277. This species was found by us to be not uncommon in a small ravine east of Puu Kolekole. It differs from *A. petricola* by the thinness of the shell and total ab-

sence of a callous rim within the outer lip. The embryo has an obtuse summit and angular periphery, the angle sometimes concealed in adult shells. Its sculpture varies somewhat, but is always fine. The neanic stage has an acute peripheral angle or a narrow keel, as far as the end of 3½ to 4½ whorls, after which the whorl becomes rounded. The peripheral whitish band is the most constant, the subsutural band being often wanting and the basal light patch mentioned in the description is generally not noticeable. The largest shell taken is 9 mm. long. The embryo figured is 2.3 mm. long, composed of 2½ whorls.

A. ALBOCINCTA Pils. & Cooke, n. sp. Pl. 3, figs. 11, 12.

The shell is perforate, oblong-conic, small, *thin*, somewhat shining, more or less daubed with dirt in life. Spire straightly conic, tapering to a minute apex. Embryonic whorls drawn out, strongly convex, very delicately striate, having a silky luster. Neanic whorls convex, angular at the periphery, the angle concealed in adults, or sometimes visible just above the suture. Last whorl rounded, having sculpture of irregular, delicate growth-striæ, liver-brown, more or less streaked with yellow, and having creamy bands at suture, periphery and around the columella, the sutural and columellar often obsolete. The aperture is dark within, lip not in the least thickened.

Length 9.3, diam. 5 mm.; 5½ whorls.

Molokai: northwestern ravine of Kamalo, just above the ditch trail, on a steep, wooded slope. Pilsbry and Cooke, Jan. 29, 1913. Cotypes 108689 A. N. S. P. and in Bishop Mus.

This species resembles *A. tricincta* in size, color, and in the thinness of the shell. The spire is more slender than in that species, with the tip more produced and acute. The embryonic shell (pl. 3, fig. 12, length 2.6 mm., of 2¾ whorls) is more oblong, with only an indistinct peripheral angle.

A. petricola Newc., of which we have seen a number of examples, is a much more solid shell, with more obtuse apex. *A. pusilla* Newc. is more solid than *A. albocincta*, with coarser embryonic sculpture. *A. albocincta* and *A. tricincta*

serve to connect the series of *A. petricola* and that of *A. pusilla*, and it is doubtful whether these small Amastras should not all be placed in one "series." *A. pusilla* has not been found by any subsequent explorer of Lanai, its habitat on that island resting upon Dr. Newcomb's statement only.

Mauian Amastras.

A. GONIOPS P. & C., n. sp. Pl. 4, fig. 1 to 5.

The shell is imperforate or narrowly perforate, solid, biconic, vandyke brown, the denuded surface in front of the aperture usually lighter, pecan brown; rather dull. Surface lightly marked with growth-wrinkles, sometimes having some spiral striæ above the periphery. Periphery acutely angular or carinate in front, becoming rounded in the last half or less. Spire convex in the lower, slightly concave in the upper part. Embryonic whorls very finely, sharply striate, the embryonic shell (fig. 2) angular at the periphery, very similar to that of *A. obesa*. Aperture quite oblique, the interior white, or tinted with pale blue, pink or violaceous; lip-rib strong, nearly white. Columella short, with a strong, not very oblique fold.

Length 11.2, diam. 7.2 mm.; 5½ whorls.

Length 11, diam. 7 to 7.5 mm.

West Maui: upper Olowalu gulch (D. Thaanum, July, 1913). Cotypes in coll. A. N. S. P. and Bishop Museum. Also in coll. D. Thaanum. Mt. Lihau and Mt. Helu, rare (Thaanum).

A peculiar and strongly individual species having some affinity to the much larger and rougher *A. nigra*. The dense texture, smooth surface, half-carinate last whorl and Cyclamastra-like apical whorls are its most striking features. It was found in some abundance in the type locality. It does not agglutinate, though a few shells are dirty (fig. 4), as in all Amastras. *A. agglutinans* Nc., of West Maui is quite different, being more depressed, umbilicate, loaded with dirt at the periphery, and it has the rough cuticle of *A. obesa*.

A. BALDWINIANA Pilsbry. Pl. 8, figs. 1, 2, 3, 4.

Vol. XXI, p. 292. The types from Mr. Baldwin were from "Lahaina," a district taking in a large segment of the southwestern mountains. Olowalu in Lahaina district, is the largest valley on the southern slope. From the sea one looks up a vast gorge cleaving the very heart of the mountains, and terminating in a wall set with peaks. In this gulch Mr. Thaanum took a large series of shells which materially add to our knowledge of this species.

At the highest locality it was found, there are a few shells agreeing well with the types except that they are as conspicuously malleated as *A. nigra*. The smaller shells of this lot are often less malleated, and are similar to those from lower in the gulch.

In the lower locality, out of 390 shells taken, only three are as large as the types, measuring 19, 21.5 and 22.5 mm. respectively. The usual length of adults is 15 to 16 mm. In many shells the cuticle is unfigured except for longitudinal streaks, but others have zigzag or mesh markings as in the *affinis* group, in mummy brown on a pale ochraceous buff ground, on part of the penultimate and last whorls, finally becoming solid chestnut-black on the last half whorl or less. Until the last whorl there is a delicate carina at the periphery, often visible above the last turn of the suture, and sometimes this persists as an inconspicuous angle on the front of the last whorl; most of the shells are somewhat malleate, but some show no malleation. The embryo shells are either apricot buff or chestnut brown.

We cannot point out any important distinction between many of the small, unmalleated specimens of *baldwiniana*, and *A. conifera* Smith, of Kula, East Maui. The peripheral carina persists longer in the latter; none I have seen are malleate, and it is not known to develop a large form like typical *baldwiniana*. Whether the two are specifically distinct is uncertain. The localities are now separated by a wide area barren of forest shells. The forests of Kula district are mostly dead or dying. I do not know that any collector since the time of Gulick has found *A. conifera*.

Gulick's localities are very trustworthy, but we would like to see that of *A. conifera* verified.

A. b. kahakuloensis P. & C., n. subsp., pl. 8, figs. 5, 6. Another form of *baldwiniana* taken at Kahakuloa, W. Maui by Mr. Thaanum, is much more slender than any from Olowalu. A keel is generally visible above the suture towards its end, and there is sometimes a little malleation. The mummy brown cuticle is conspicuously streaked with whitish and on the last half whorl with black or blackish. The surface under it is pinkish buff or almost white.

Length 17, diam. 8.5, aperture 7 mm.; 6½ whorls.

Length 16.5, diam. 9, aperture 8 mm.

A. AFFINIS (Newc.). Pl. 6, figs. 12 to 19.

Vol. XXI, p. 297. A large series recently collected by Mr. Thaanum in the Polipoli Forest Reserve, Kula district (pl. 6, figs. 15 to 19) shows great variation. The shape varies between length 15.2, diam. 7.3 mm. and 13 x 7.3 mm. The ground color may be light buff, ochraceous buff, buff-pink prussian red, purple-drab, or various more neutral tints. Some shells are pale below as in Vol. XXI, pl. 44, fig. 8. The outer thin cuticle is usually figured in zigzag-netted pattern, often wholly absent.

In Auwahi (pl. 6, figs. 12, 13, 14), a couple of miles from Polipoli, the shells have mainly a dull or dead appearance, with the cuticle largely deciduous, what remains being usually dense and opaque, as in Gulick's *rustica*.

It seems obvious from these lots that the supposed subspecies or varieties *pupoidea*, *bigener*, *bigener abbcrans*, *subpulla* and *cinderella* are merely mutants of *affinis*, and without racial significance.

A. LAHAINANA P. & C., n. sp. Pl. 6, figs. 1 to 10.

The shell is perforate or closed, ovate-conic, thin but rather strong, not glossy, having rather coarse growth-striæ near the suture, elsewhere weak. Color variable: carob brown, russet, apricot buff, ochraceous buff, or nearly white; sometimes the color is bipartite, light with a dark base or light

with a dark spire, rarely dark with a light base. Rather rarely there is a thin fragmentary outer cuticle, ivory-yellow with zigzag or netted markings of mummy brown. The embryonic whorls (fig. 10) are more convex and more finely costulate than in *A. affinis*. The embryonic shell is either chestnut brown, pinkish buff or cream, and usually has oblique corneous markings on the last half whorl. The aperture resembles that of *A. affinis*; outer lip scarcely thickened within; columellar fold strong.

Length 10.2, diam. 5.7, aperture 5 mm.; 5½ whorls.

Length 11, diam. 6, aperture 5.2 mm.

West Maui: Olowalu Gulch, district of Lahaina, D. Thaanum. Cotypes in A. N. S. P. and Bishop Mus.

A very pretty species, closely related to the East Mauian *A. affinis*, and like that variable in color. The embryonic whorls are more convex, more finely costulate, and show the keel less; the shell is smaller than the average *affinis*, and the columellar lamella is a little larger.

A. LINEOLATA (Newcomb). Pl. 7, figs. 18, 19.

Vol. XXI, p. 320. Newcomb's collection contains three specimens on the *lineolata* cord, one having been broken off, probably to send to London for illustration in his paper of 1853. The three specimens represent two species. One shell has the "umber colored zigzag lines," and must therefore be the type. The other two have no dark markings. They agree with Newcomb's figure in P. Z. S., copied in volume XXI, pl. 45, fig. 9.

The specimen which we take to be the type (pl. 7, figs. 18, 19), is openly perforate, rather thin. The spire is convexly conic below, but a little concave towards the summit. First half whorl smooth, next whorl flat, coarsely costate, carinate at the lower edge. The ribs are finer on the succeeding whorl, towards the end of which they disappear except below the suture. Following whorls have faint growth-lines. The shell is pinkish under a thin tawny-olive cuticle, which is marked with a darker shade (Saccardo's umber) as shown in the figure. The embryonic whorls are brownish.

The aperture is rather narrow; outer lip thin; columellar margin is reflected half over the umbilical crevice, and bears a small, steeply ascending lamella. Length 11.4, diam. 5.5 mm., aperture 5 mm.; 5½ whorls.

It will be noted at once that the apex, the pattern of color and the columellar fold are those of *A. affinis*; but the shell is more slender than any *affinis* we have seen; it is also somewhat thinner, and has a conspicuously open perforation. We can only suggest that *lineolata*, as a close ally of *affinis*, is to be looked for in Maui.

A. NEGLECTA n. sp. Pl. 7, fig. 20.

The other two shells on Newcomb's card of *lineolata* differ from the preceding in the following particulars. They are imperforate, like *A. affinis*; the shape is more broadly and regularly conic; the cuticle shows no dark variegation whatever; the aperture is wider, and the columellar fold is decidedly stronger and ascends less steeply. It seems to have been a shell of this kind which Newcomb figured in the P. Z. S. It is covered with a tawny-olive cuticle, and is bluish white where this is eroded in front of the aperture; apical whorls brown. It differs from *A. affinis* by the straightly conic spire, which is narrower towards the apex, by the stronger, less steeply ascending columellar fold, and the absence of variegation.

Length 12.7, diam. 6.2, aperture 5.5 mm.; 6 whorls.

Length 12, diam. 6.7, aperture 5.5 mm.; 6 whorls.

Maui ? Type in Newcomb coll., Cornell University.

? *Achatinella lineolata* NEWC., P. Z. S. London, 1853, pl. 23, f. 29. Not the description.

While decidedly of Mauian type, we cannot unite this with *A. affinis* or any allied species seen. *A. johnsoni* (which may prove to be a dark form of *affinis*) differs in shape, color and the columellar fold. *A. amicta*, which seems close to *neglecta* in shape, is described as differing by its rough epidermis and purplish color. Its apex is undescribed, and the locality unknown.

It will be noticed that neither of these shells agrees exactly

with Newcomb's measurements. But neither do his measurements agree with the figure in P. Z. S., since that figure has about the same ratio of breadth to length as these shells, whereas Newcomb's measurements represent it as a decidedly narrower shell. This is not to be taken too seriously, however, as there are various ways of measuring the diameter of a shell of this shape, and moreover his measurements were probably read off of a flat scale, giving room for mistakes.

A. FARCIMEN (Pfeiffer). Pl. 1, fig. 9.

Vol. XXI, p. 291. Mr. E. A. Smith had our figure of the type-specimen made. This looks like a sinistral specimen of the *pupoidea* form of *Amastra affinis*, such as that figured in Vol. XXI, pl. 44, figs. 10, 11. The position of *farcimen* depends, however, upon the apical sculpture, which is not known to us. It does not look like a *Heteramastra*.

A. MASTERSI (Newc.). Vol. XXI, p. 296. 4th line from bottom in place of *northeastern* read *western*.

Section HETERAMASTRA Pilsbry.

A. SOROR (Newc.).

Vol. XXI, p. 285. Part of the specimens taken by Mr. Thaanum in Olowalu gulch, West Maui, have markings recalling *A. affinis* Nc.

A. PILSBRYI Cooke. Pl. 4, figs. 6, 7, 8.

Shell imperforate, sinistral, elliptical with conic spire which is somewhat contracted near the summit. One cotype is of an old gold color, streaked with chestnut behind the outer lip, and with the spire brownish; the other (dead) cotype is wax yellow in front of the aperture, elsewhere with a yellow gleam under a pale tawny cuticle, the last third of the last whorl chestnut. Surface of the last whorl semi-matt, the spire more shining; smooth to the eye, but under the lens unequal growth-wrinkles are seen. Embryonic whorls carinate, the keel visible above the suture; first half whorl nearly smooth, the next two whorls sculptured with regular, slightly arcuate

ribs, at first rather coarse, becoming finer to the end of the embryonic shell, which comprises 2½ whorls (fig. 7). Whorls 5½, convex, the neanic whorls carinate, the keel usually concealed in adult shells; the last whorl is swollen below the deeply impressed suture, ventricose, tapering below. The aperture is rather long and narrow, slightly oblique, white within. Peristome slightly thickened close to the edge. Columellar lamella of moderate size, thin and spiral, white; parietal callus thin.

Length 13.1, diam. 7.7, length of aperture 7 mm.

Length 13.4, diam. 8.1, length of aperture 7.1 mm.

West Maui: Mt. Helu. Cotypes in coll. Bishop Museum and no. 108170 Acad. Nat. Sciences. Also in Mr. Thaanum's collection.

Amastra pilsbryi Cooke, Nautilus xxvii, Oct., 1913, p. 68.

A. fraterna Sykes of Lanai has some resemblance to this species, being of stouter contour than other Heteramastras. Although *A. pilsbryi* has the stout contour and carinate, costate embryo of typical *Amastra*, it is perhaps to be regarded as a stout species of *Heteramastra*, the wholly unfigured cuticle favoring this view. It is rather isolated in the fauna as at present known, and does not readily fall into any of the recognized groups.

A. elongata (Newcomb). Pl. 2, fig. 18.

Vol. XXI, p. 230. Three specimens are no. 29960 of the Newcomb collection, Cornell University. One of these may be the type which was said to be unique, but none agrees exactly with Newcomb's measurements. It is a shell having the color and texture of *A. subsoror*, with which it agrees in the long, convex embryonic whorls. The surface may be a little rougher. It differs from *subsoror* in the decidedly more elongate shape and consequently smaller aperture. It differs from *A. perversa* by the longer, more convex embryonic whorls. Seems to be a valid species, close to those of Maui and Molokai. Length 10.9, diam. 5.2, aperture 4.4 mm.; 6¼ whorls.

A. SUBSOROR H. & P. Pl. 3, fig. 13.

Vol. XXI, p. 287. The exact locality of this species is not known. Two of the three lots seen are without habitat, the other lot being labeled *Lahaina, Maui,* by Gulick. The summit of one of the type lot is figured on pl. 3.

A. subsoror auwahiensis P. & C., n. subsp. Pl. 5, figs. 8, 9, 10.

The shell is sinistral, imperforate, thin, ovate-turrite, chestnut-brown, the cuticle becoming yellowish on the spire in old shells; lusterless, irregularly striate and having occasional rather prominent wrinkles. Sculpture of the embryo fine, close and delicate (too coarse in fig. 10). The last whorl is swollen. Outer lip fragile. Columellar fold small and very oblique.

Length 11.1, diam. 6.25, aperture 5.25 mm.; 5¾ whorls.

Length 12, diam. 6.25, aperture 5.3 mm.; 6 whorls.

East Maui: Auwahi, at 4200 ft., very abundant.

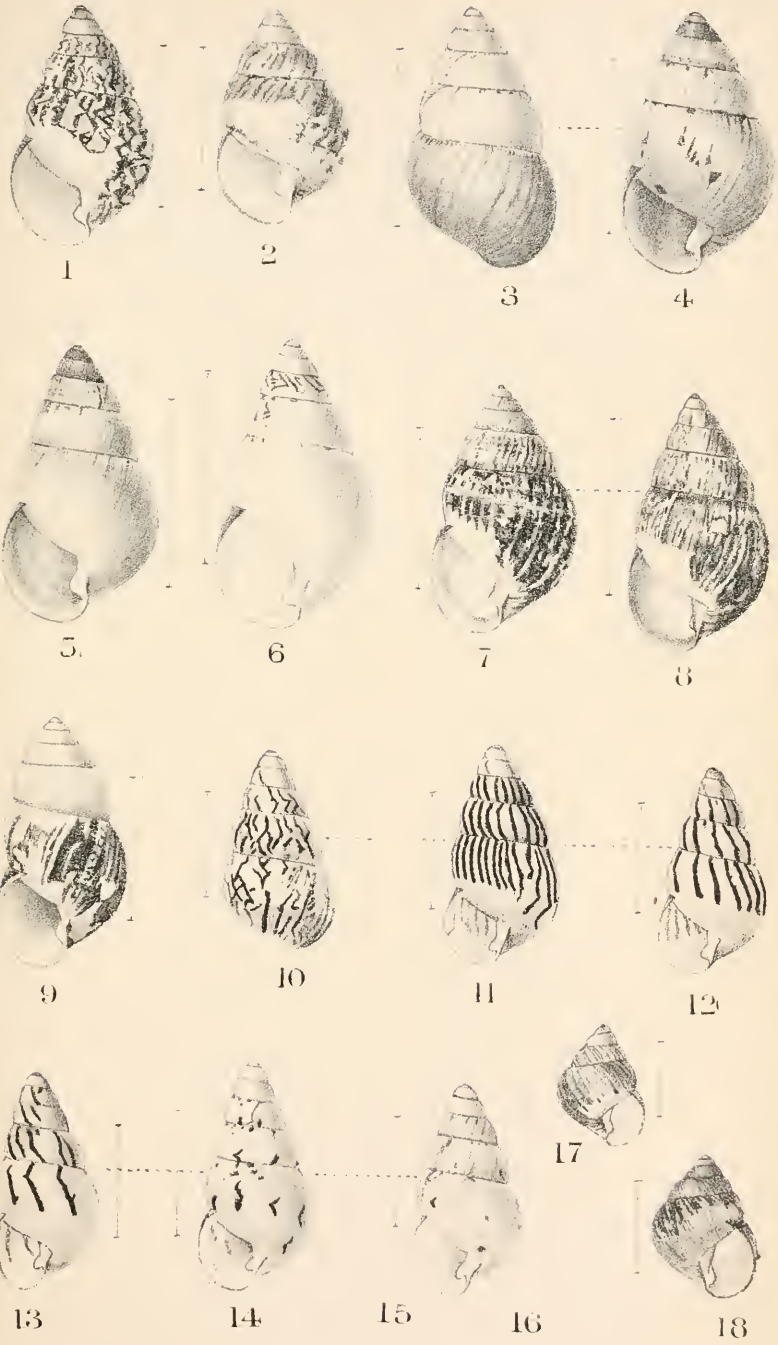
Differs from *subsoror* chiefly by its more robust contour, the last whorl being more swollen, and the shell larger in every way. The sculpture of the apex is about the same. It was found in fine dirt around and under rocks or occasionally attached to them.

Auwahi is on the slope of Haleakala facing Hawaii, just above Ulupalakua.

Hitherto *A. læva* and *A. hutchinsonii* were the only Heteramastras known from East Maui; but Mr. Thaanum's find shows that the group of forms supposed to be West Mauian is also represented in the east. Curiously enough, they were found in the southern slope, and not on the less remote Kula side.

A. NUBIGENA Pils. & Cooke, n. sp. Pl. 5, figs. 11, 12; pl. 3, fig. 15.

The shell is imperforate, sinistral, solid but rather thin, ovate-turrite, dark chocolate-colored, pale around the columella. Surface matt except in front of the aperture, where the very thin outer cuticle is worn off. Outlines of spire slightly concave above. Apex rather acute, the initial half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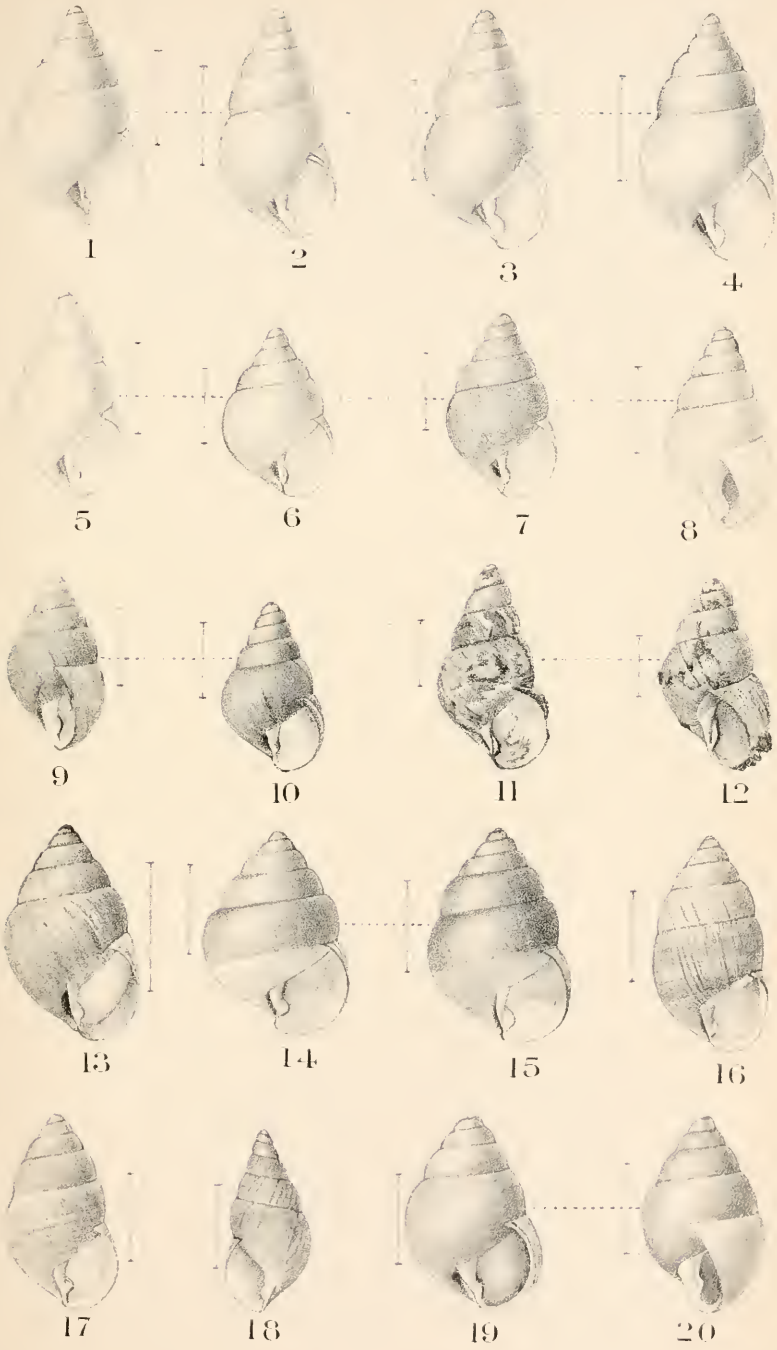
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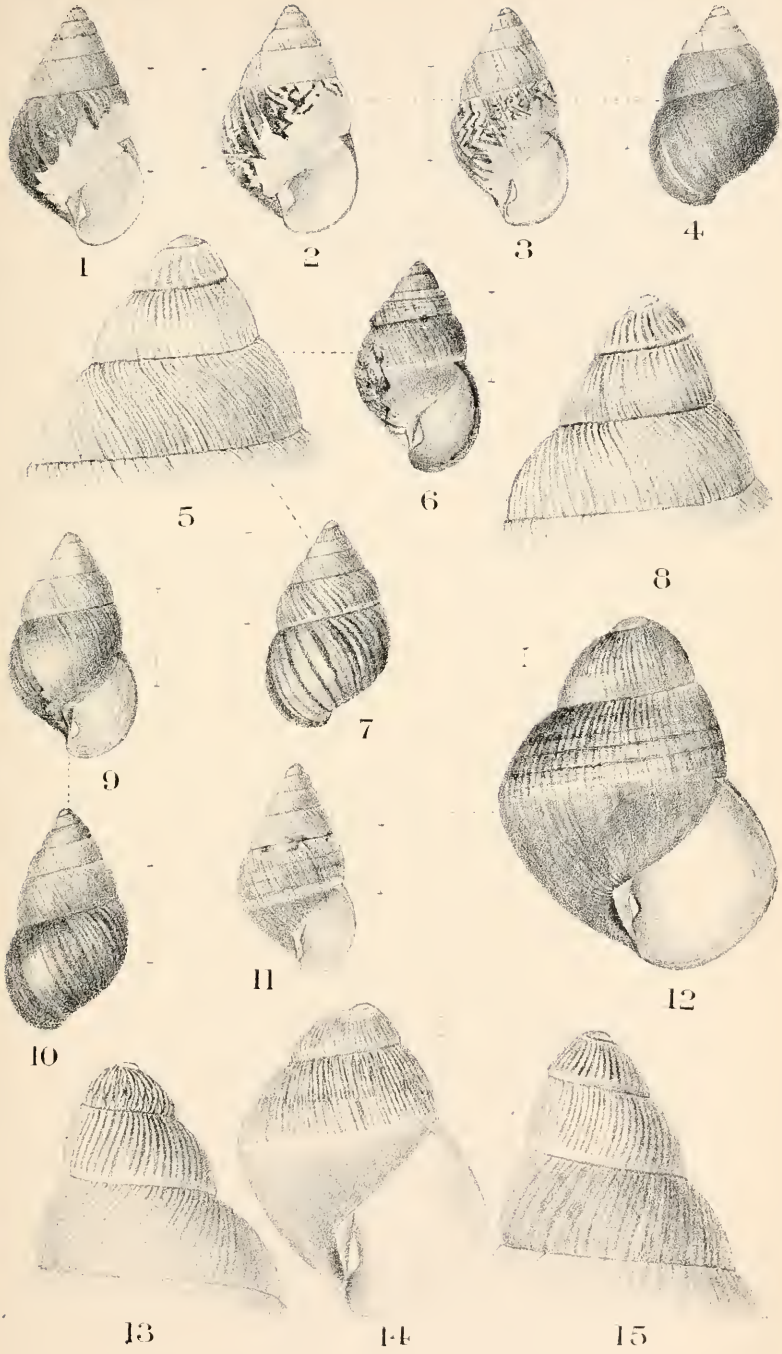
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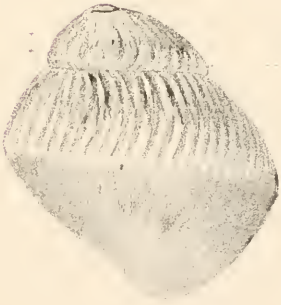

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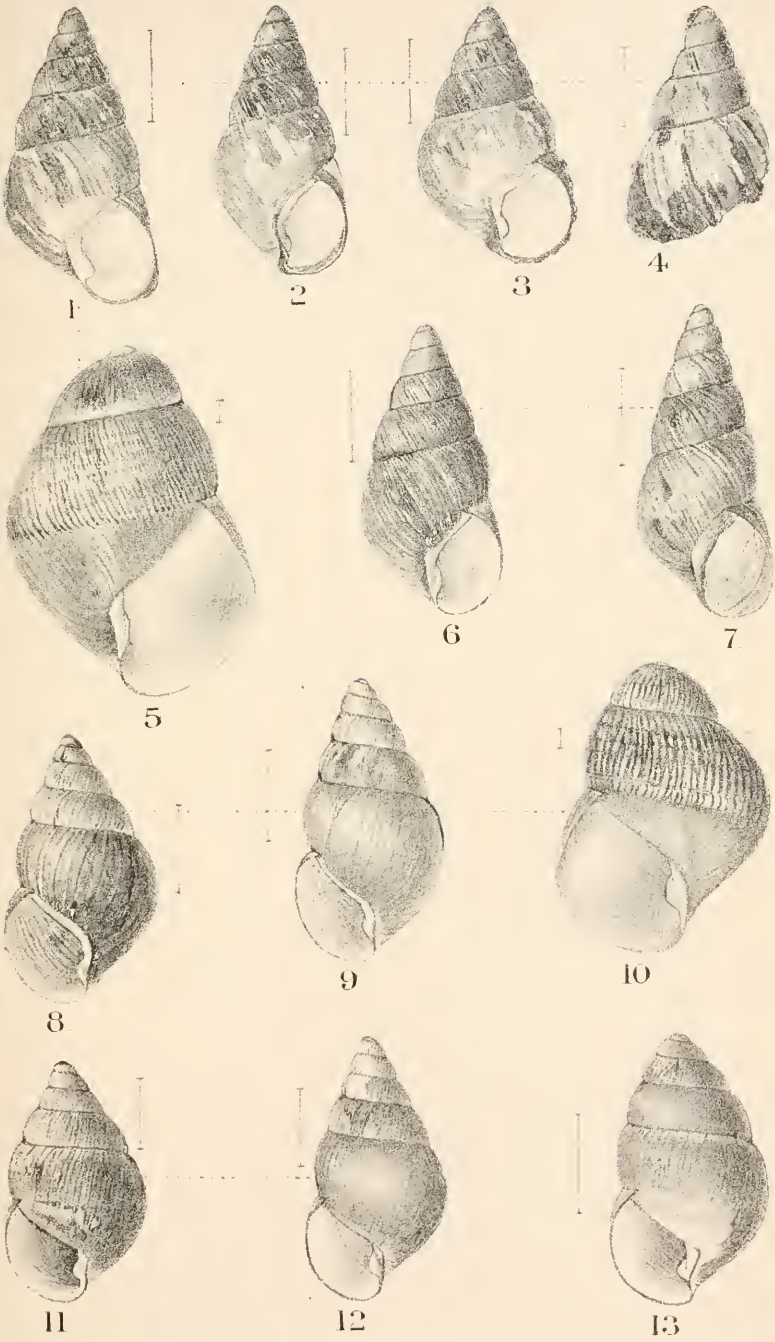
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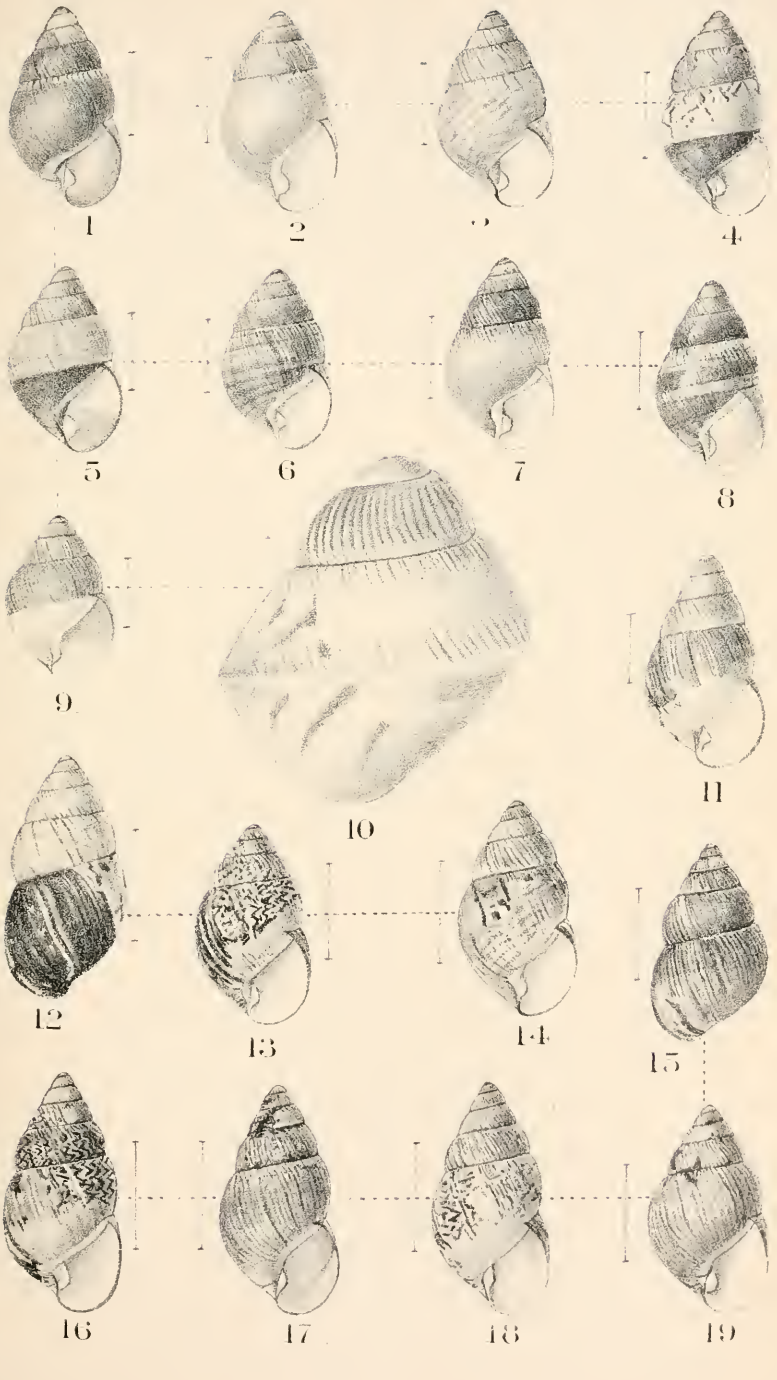
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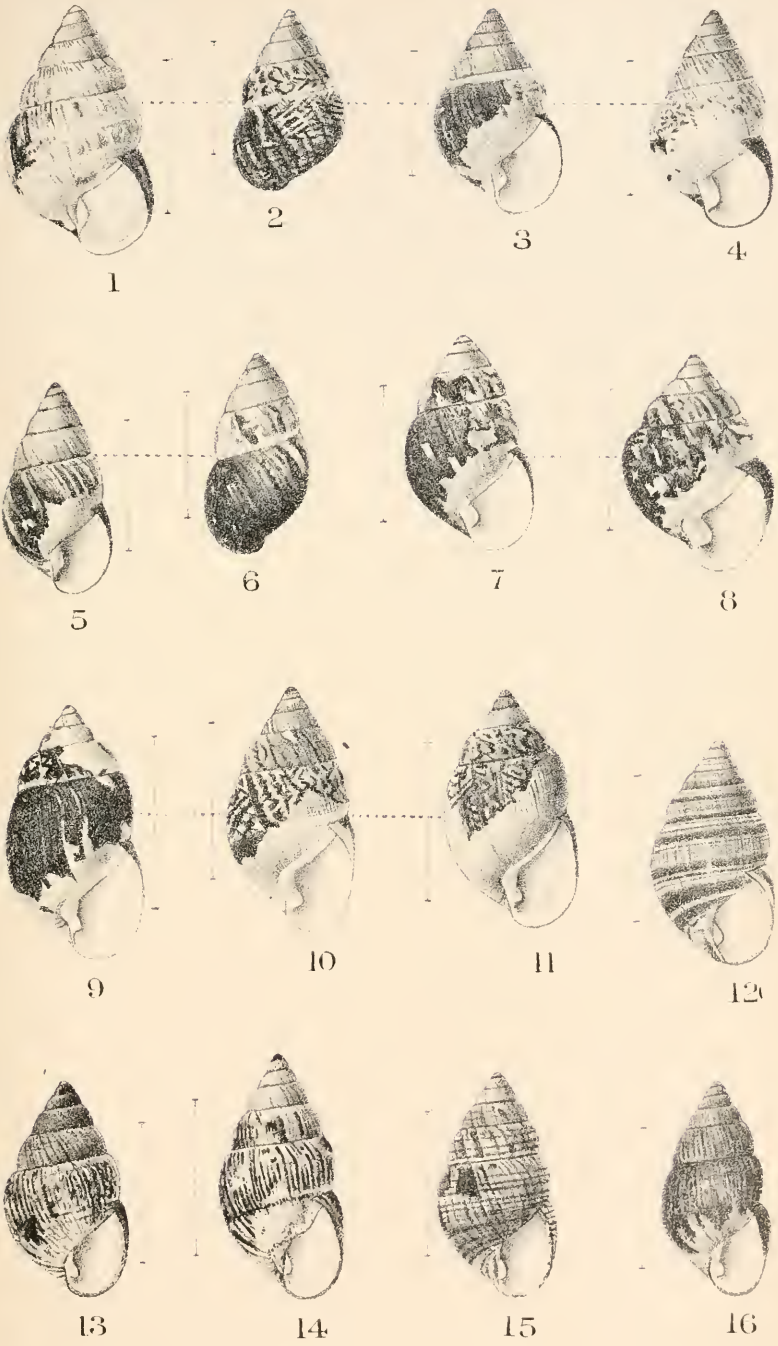
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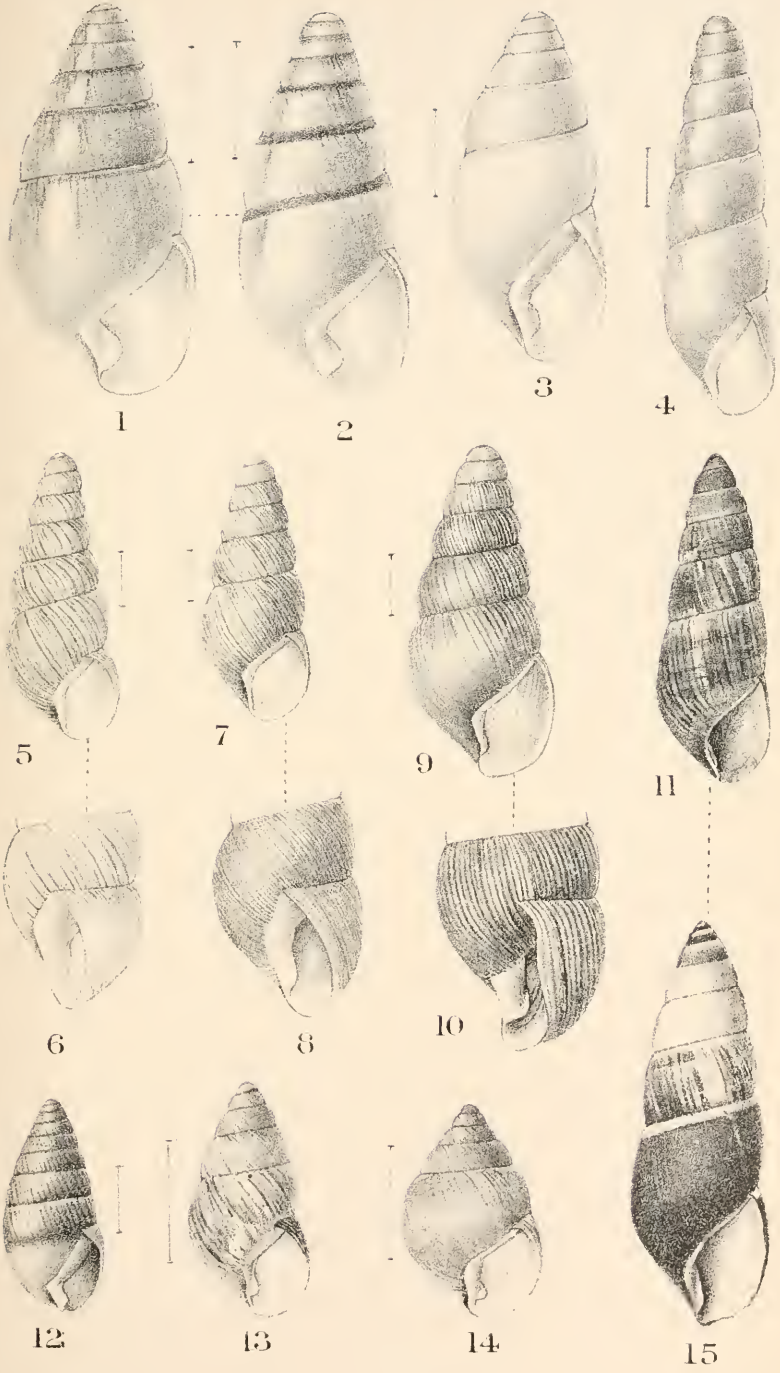
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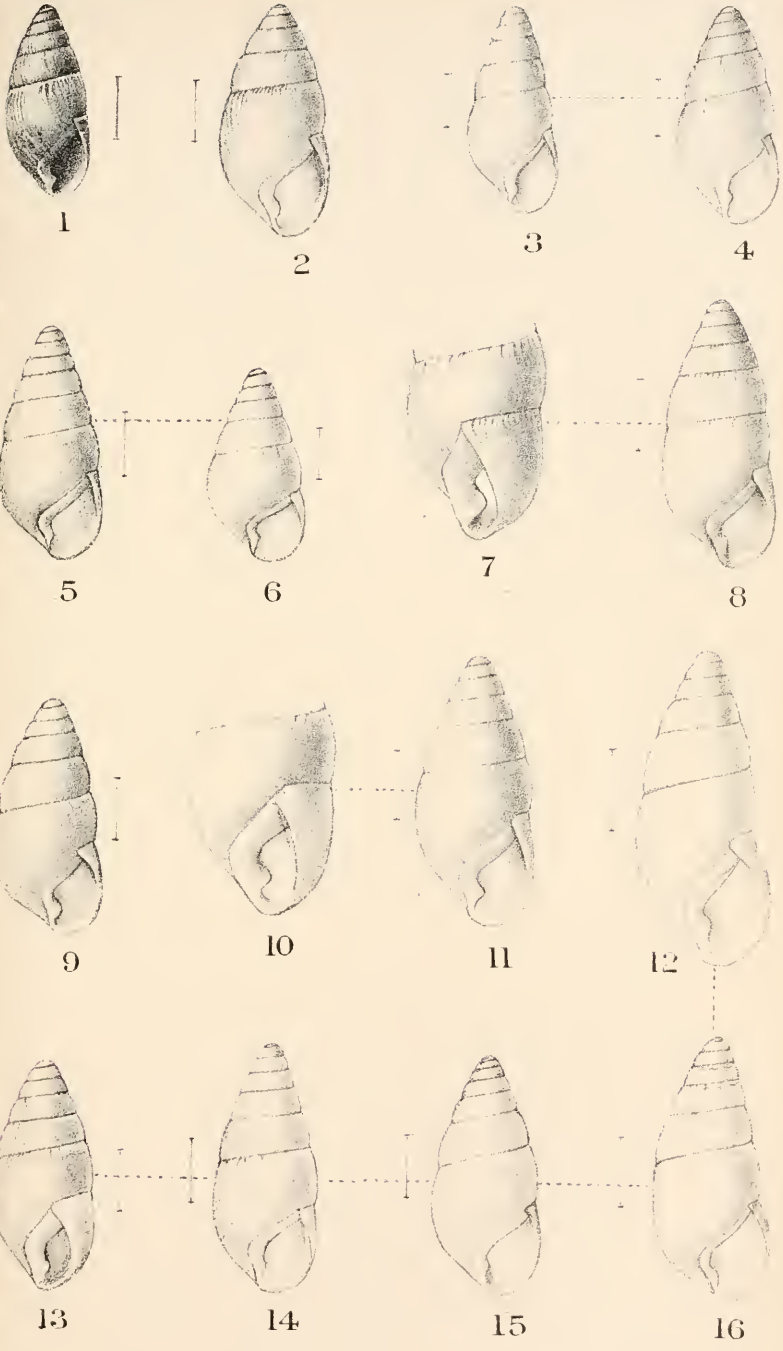
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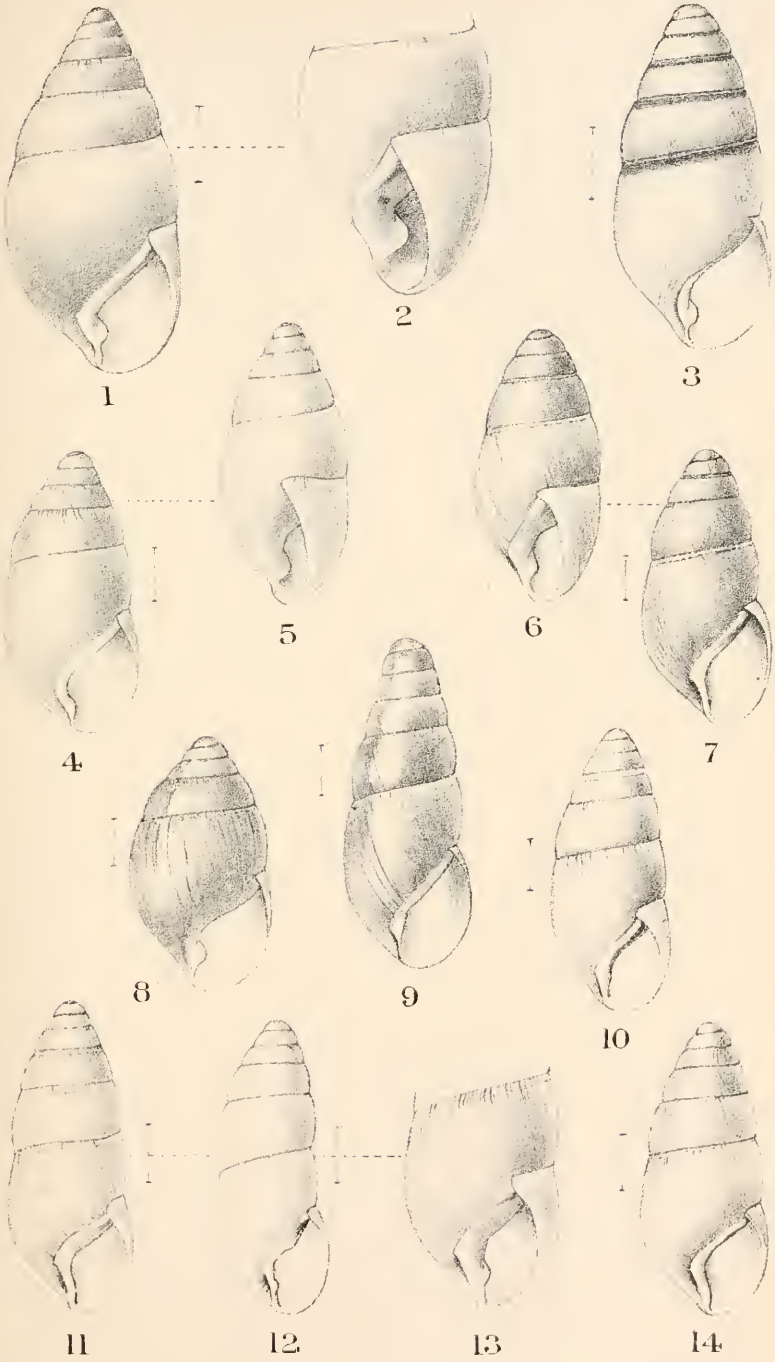
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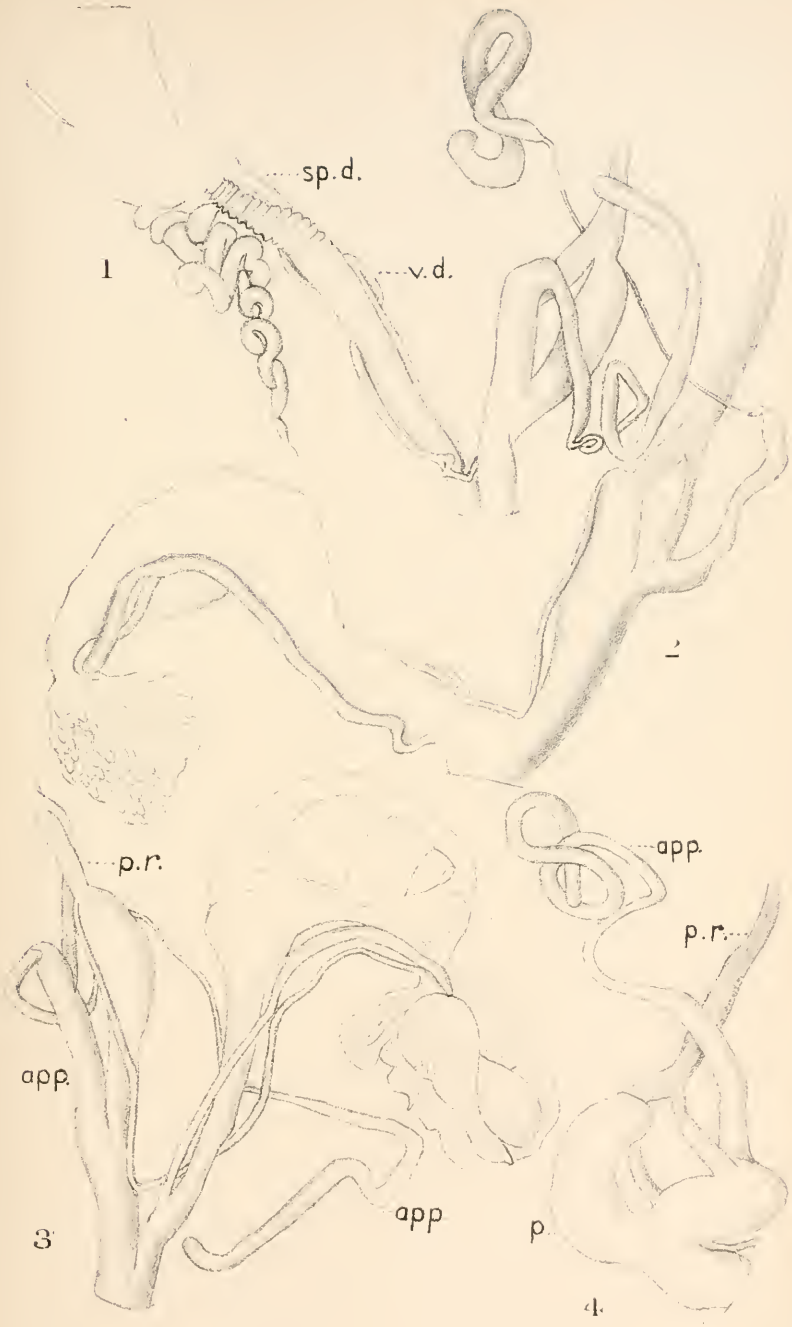
sp.d.
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1
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whorl smooth, next whorl having rather coarse, arcuate riblets, and carinate above the suture; the following whorl more closely and sharply rib-striate (pl. 3, fig. 15). Neanic whorls carinate, the carina showing above the suture on some of the whorls, becoming obsolete on the penultimate whorl; last whorl more or less swollen. The outer lip has a white internal thickening; columellar lamella moderately strong, oblique.

Length 10, diam. 5.7, aperture 4 mm.; 6¼ whorls.

Length 10.2, diam. 5.5, aperture 4.3 mm.; 6¼ whorls.

Length 9.3, diam. 5.6, aperture 4 mm.; 5¾ whorls.

West Maui: gulch to the right of Maunahoomaha, above Lahaina, D. Thaanum, 1913. Cotypes in A. N. S. P. and Bishop Mus. Also reported by Mr. Thaanum from Mt. Helu, Honokawai gulch, Moomuku and Honokohau.

This form has coarser ribs on the embryonic whorls than any of the related species, and the second embryonic whorl is flatter. The shell is larger and much more solid than *A. subsoror*. As in that, there is a small pale tract around the columella, the rest of the shell being very dark brown.

Hawaiian Amastras.

A. MELANOSIS (Newcomb). Pl. 1, fig. 17.

Vol. XXI, p. 312. Having examined a paratype from Newcomb's collection (pl. 1, fig. 17, no. 30,014 Cornell Univ.) we are satisfied that his *melanosis* was based upon immature shells, lacking almost or quite a whorl of maturity, and corresponding exactly with the immature stage of the shells figured in Vol. XXI, pl. 47, figs. 1, 2. These shells were from Mr. Baldwin, labeled *Hamakua*. Probably obtained by him from Mr. Horner. Their exact locality could doubtless be traced. Newcomb's label however says "Mauna Loa, Hawaii." Very little importance is to be attached to this, since Newcomb himself did not collect the shells, and it is very doubtful whether such an *Amastra* occurs on Mauna Loa unless so far down as to rob the term of any definite geographic significance. At all events, the Hamakua shell appears to be the typical form of *A. melanosis*.

Dr. Newcomb's original figure, copied in Vol. XXI, pl. 47,

fig. 6, was enlarged. A figure of the specimen in his collection is given on pl. 1, fig. 17. It measures, length 9.9, diam. 7.1 mm., with 5 whorls.

A. melanosis kauensis P. & C., n. subsp. Pl. 1, fig. 18.

The shell has the short, wide contour of Newcomb's type figure of *melanosis*. The cuticle is dull brown with darker streaks, and is in large part deciduous in adult shells, exposing the dull, flesh-tinted, somewhat chalky substance of the shell. The embryo is acutely angular, the angle continuing to the middle or rarely to the end of the last whorl. It is concealed on the spire except in the last half or third of a whorl, where it is exposed by the slight descent of the last whorl. The umbilicus is open and half covered in some, wholly closed in other examples.

Length 11.8, diam. 8.25 mm.; 5½ whorls.

Length 11.2, diam. 7.6 mm.

Waiohinu, Kau, near the southern end of Hawaii, Mr. Thaanum. Cotyes no. 108147 A. N. S. and in Bishop Mus.; it is also in the Thaanum collection.

This form is larger than the type of *melanosis*, but shorter and broader than what we take to be the adult form of that species.

A. FLAVESCENS (Newcomb).

Vol. XXI, p. 315. In its various varieties, this species probably has colonies in every forest district of Hawaii. In specimens from Newcomb, figured in Vol. XXI, the last whorl is rounded. A series from Gulick, without exact locality, has it more or less angular in front. Two specimens from Newcomb measure:

Length 16.5, diam. 9, aperture 7.5 mm.; 6⅕ whorls.

Length 15.3, diam. 8, aperture 7 mm.; 6 whorls.

In *A. f. saxicola* Bald. the *whorls are more convex*, the last one rounded peripherally. This is the race from far south, the type from an aa flow on the Kahuku ranch, Kau.

A form from South Kona, which Mr. Baldwin erroneously sent as *A. henshawi* (Vol. XXI, p. 318, last paragraph, and pl. 47, fig. 15), is similar to *flavescens* except that it is more

slender with smaller aperture. The whorls are rather flattened, as in typical *flavescens*, with the suture less impressed than in the following form.

Eastern form (pl. 9, fig. 13). A large series from Olaa, 2550 ft. elevation, collected by Mr. H. W. Henshaw, and a number from Glenwood, Olaa, taken by myself, show that the eastern form has slight racial peculiarities. The shell is in the average more slender than *flavescens* from Newcomb, with more convex whorls and smaller aperture. The last whorl is everywhere rounded. The thin cuticle on the last 2½ whorls is cream buff, streaked on the last whorl with chamois, and towards the end of the whorl often with ochraceous buff. The upper part of the spire is cinnamon or sometimes nearly as light as the later whorls. Specimens measure:

Length 15.4, diam. 7.8, aperture 6.4 mm.; 6 whorls.

Length 15.8, diam. 7.8, aperture 6.9 mm.

Length 15, diam. 8, aperture 7 mm.

Length 13.1, diam. 7.7, aperture 6.5 mm.

The last measurement is of the broadest shell in my series, the individual possibly not quite adult. Mr. Henshaw has found a less slender form, with similar coloration, at Honomou, 13 miles north of his Olaa colony.

While this eastern race seems separable from the *flavescens*, of Newcomb and Gulick, I refrain from naming it at this time, as I have no Hamakua shells with exact locality. Further comparison of good series is needed to demonstrate the value of the Olaa and the South Kona races, and their relation to Hamakua *flavescens*.

A. HENSHAWI Baldwin. Pl. 9, fig. 14.

Mr. Baldwin's description was reprinted in Vol. XXI, p. 318, but the specimen figured was a very different form which he subsequently sent out as *A. henshawi*, and not the original species. Mr. Thaanum, who put us right in the matter, kindly gave one of the original lot of *henshawi*, collected by Mr. Henshaw near the Buchholz place, Kona. It is drawn in fig. 14.

It is distinct from *A. flavescens* by its far broader contour.

The shell is solid, resembling *flavescens* in texture. It is rather sharply irregularly striate, very faintly pink under a very thin naples-yellow cuticle, which is partly deciduous, the spire cinnamon, darkening to the apex. The whorls are closely coiled, the last showing a distinct angle in front, and very shortly descending near the aperture. Suture well impressed. The columellar lamella is strong and *subhorizontal*. Length 15, diam. 9.5, aperture 7.75 mm.; 6 whorls.

Genus LAMINELLA Pfeiffer.

LAMINELLA GRAVIDA (Fér.). Vol. XXI, p. 327.

This fine snail lives on the leaves of the *oloná*, which is often referred to by collectors as the "*gravida* plant." I never saw them on any other plant. They are extremely timid, and drop to the ground at the slightest jar.

On inspection of the very large series in the Bishop Museum, the Irwin Spalding and the Thaanum collections, it is obvious that there are several local races, which it is desirable to recognize by name.

The subspecies of *L. gravida* from west of Nuuanu live in widely separated colonies, and are perfectly distinct from one another in characters. They might be ranked as species, being more distinct than many species of *Achatinella*. Those from Nuuanu eastward occupy contiguous areas and are less clearly differentiated from each other.

L. GRAVIDA DIMONDI (C. B. Adams). Vol. XXI, pl. 55, f. 1, 2, 4, 5.

The cuticle is bone-brown to black, more or less extensively deciduous in angular patches, exposing the cream or pinkish buff or almost white under-tint. Aperture white or pinkish buff within. Embryonic whorls olive-buff or some shade of brown. Size larger than in Pauoa *gravida*.

Length 26, diam. 4, aperture 2.3 mm.

Length 25, diam. 14.5 mm.

Oahu: Wailupe, Waialae (fig. 2, Cooke coll.), Palolo (figs. 1, 4, A. N. S. P.), Manoa, Mt. Konahuanui and upper Nuuanu (fig. 5, Cooke coll.).

This was mistaken for typical *gravida* in the former account. Adams' description follows.

"*Achatinella Dimondi.* Shell reversed, thick, long ovate-conic; dingy white or very pale yellowish brown, with a blackish margin to the aperture when mature; with a greenish black fugacious epidermis; with the transverse striæ rather slight, very unequal and irregular, without spiral striæ; apex subacute; spire rather long, with the outlines moderately curvilinear; whorls nearly seven, quite convex, with the suture well impressed; last whorl often somewhat flattened on the middle. Aperture subovate, with the columellar fold well developed, with the deposit on the inner side very thin; labrum sharp, not reflected, well thickened within. Mean divergence 45 degrees; length 1 inch; breadth 5 inch; length of aperture .38 inch.

"Variety (?) *lata* has a divergence, in a specimen about two-thirds grown, of 55 degrees.

"Habitat, Sandwich Islands.

"This fine species is named in honor of Mr. Henry Dimond, of Honolulu, to whom I have been much indebted for the shells of these islands." (*C. B. Adams.*)

L. GRAVIDA GRAVIDA (Fér.). Pl. 1, figs. 1, 2.

Probably the form from Pauoa valley and Tantalus is typical. This form agrees well with the original description and figure, and our analysis of Férussac's Hawaiian shells makes Pauoa the most probable locality for his species from near Honolulu. No doubt the party ascended Mt. Tantalus. This form is figured in Vol. XXI, pl. 55, fig. 3. It is small, with thin cuticle more or less deciduous, but where retained it is profusely speckled with v-shaped and zigzag lines of warm sepia, olive brown or bone brown, more or less disposed in streaks, and over a pale ochraceous salmon undertint. Embryonic whorls usually some shade of brown, sometimes olive-buff or a darker shade. Interior flesh color. Some specimens are cream-colored under the cuticle, with the aperture warm buff. The largest specimen found by the senior author is 21.3 mm. long.

Oahu: Bowl of Tantalus (pl. 1, figs. 1, 2).

L. GRAVIDA SUFFUSA (Reeve). Vol. XXI, pl. 55, figs. 7, 8.

Cuticle almost entirely wanting, the shell pink or white;

embryonic whorls very pale. Eastern side of lower Nuuanu Valley.

L. GRAVIDA KALIHIENSIS P. & C., n. subsp. Pl. 1, fig. 6.

Shell large, between white and marguerite yellow, with only small traces of a thin, very pale buff cuticle, which, where sufficiently preserved, is seen to be profusely figured with v or w-shaped olive lines; the embryonic whorls being straw yellow or paler; interior white.

Length 25.5, diam. 14, aperture 12 mm.; 7 whorls.

Length 27, diam. 14, aperture 12 mm.

Oahu: Kalihi. Cotypes no. 109905 A. N. S. P. and no. 25878 Bishop Museum.

L. GRAVIDA AURANTIUM P. & C., n. subsp. Pl. 1, figs. 3, 4, 5.

Shell ochraceous-orange, deepening to apricot-orange or almost coral pink near the outer lip, fading upwards to warm or light buff, the embryonic whorls some shade of ochraceous-buff or of brown; cuticle almost entirely deciduous, but when remaining it is transparent, with irregular dusky markings. Interior geranium pink.

Length 23, diam. 13.7, aperture 11 mm.; 7 whorls.

Length 23, diam. 12 mm.

Length 21, diam. 13 mm.

Length 26.2, diam. 15.2 mm. (Head of Waiawa).

Oahu: main ridge, above Waiahole, D. Thaanum. Cotypes no. 109904 A. N. S. P. and in Bishop Mus. Head of Waiawa (probably near the same place), Spalding, Kuhns. Eastern ravines of Kaliuwaa, Irwin Spalding. On *Olona*.

Notable for its rich color. The specimens from Kaliuwaa often have a more turrite shape and are paler, light buff, becoming warm buff or ochraceous orange anteriorly, embryonic whorls liver brown. The aperture however is beautifully colored, geranium pink or rose doree (pl. 1, fig. 5).

Length 25, diam. 13.2 mm.

Length 22.2, diam. 13 mm.

L. GRAVIDA WAIANAENSIS P. & C., n. subsp. Pl. 1, figs. 7, 8.

The shell has a dead, lusterless surface, cartridge buff to

nearly white, partly covered with narrow shreds of sepia cuticle, which becomes blackish towards the end of the last whorl; embryonic whorls with more or less flesh tint. Aperture white within, but with a livid purple border, generally broad, within the lip; columella dark red. Length 23, diam. 12.5 mm.

Oahu: Haleauau, Waianae Mountains. Cotypes in coll. A. N. S. P. and Bishop Mus.

This race was mentioned as a form of *L. straminea* in Vol. XXI, at the foot of page 329. A specimen from Dr. Cooke's no. 1778 from the Waianae range was figured on pl. 55, fig. 6, but, by some oversight, in the explanation of plates the figure was said to be from a Nuuanu shell.

L. SANGUINEA (Newc.). Vol. XXI, p. 330.

The paragraphs at foot of page 332 and top of p. 333 belong to *L. gravida* and not to *L. sanguinea*. Mr. Oleson's note seems to have been misplaced in the MS., and the error was overlooked in the proofs.

Many years ago Mr. Joseph Emerson found *L. sanguinea* on the south side of Anahulu river, in Kawailoa, but not on the north side. This appears to be its western limit.

Newcomb's type figure of *L. sanguinea* is reproduced photographically on pl. 29, fig. 15 of Vol. XXII.

Var. *leucoderma*. Ground color white with the faintest suggestion of pink, under a very pale buff cuticle, marked with black as usual. Interior white; columella, parietal wall and a lip-border more or less pink; summit dark, as in typical *sanguinea*. Size small. Length 17 mm., 5½ whorls.

Near the middle of the western ridge of Popouwela, Waianae Mts., on ieie. Spalding, Pilsbry and Cooke.

Occurs as a pure race, so far as we know.

L. ALEXANDRI (Newc.). Pl. 1, figs. 10 to 16.

Very large and handsome specimens have been collected on Mt. Kukui, West Maui, by Mr. Thaanum. A series is figured. In most of them the black lines are straight, but in a few they net together (fig. 10), and rarely they almost disappear, only some dots remaining (figs. 14, 15-16). The largest shells measure 18 x 8.5 mm.

L. A. DUOPLICATA Baldwin, taken in Iao valley by Mr. Thaanum, is broader and shorter in figure than Mr. Baldwin's types, and the whorls are more convex. Some specimens have no black markings.

L. KUHNSI Cooke. Vol. XXI, p. 343.

Some specimens from Kahakuloa, the type locality, have no black markings. Others, from Ahoa, are copiously marked with oblique, more or less zigzag and netted lines. In a few the lines are sunken, as in *L. aspera*.

L. CITRINA ('Migh.' Pfr.). Vol. XXI, p. 350.

Waihanau, and between Kahananui and Ualapue (Thaanum). Pipe-line trail near mouth of tunnel, upper Kaunakakai; bottom of ravine east of Puu Kolekole (Cooke and Pilsbry).

The Waihanau lot contains also specimens of the color-form *semivenulata*, which is certainly not a subspecies, merely a mutation occurring in some colonies.

Mr. Thaanum found a pure colony of dextral *citrina* at Kalamaula. All the embryos examined were dextral.

L. DEPICTA Baldwin. Vol. XXI, p. 345.

In deference to the opinion of Doctor Cooke and Mr. Thaanum this is now ranked as a species distinct from *L. alexandri*. Mr. Thaanum has two dextral individuals. Exactly where in Kamalo the typical form (Vol. XXI, pl. 52, figs. 10, 13-16) was found we do not know.

L. depicta kamaloensis P. & C. A form found in northwestern Kamalo above the amphitheatre, along the old Kamalo ditch, differs from *depicta* by its constantly smaller size, more convex whorls, the last more inflated, and by the decadent and fragmentary pattern of black on a ground varying from straw yellow to apricot buff. It was taken in some abundance by Cooke and Pilsbry in several places in the district mentioned, and has also been found by Mr. Thaanum, who took the shells figured in Vol. XXI, pl. 52, figs. 6, 7, 8.

Length 12, diam. 6.2 mm., 5½ whorls.

SOFT ANATOMY OF THE ACHATINELLIDÆ.

Externally the animal of *Achatinellidæ* does not differ noticeably from that of *Partulidæ* or of *Bulimulidæ*. The foot is usually shorter than the shell, rather broad, without division into longitudinal areas. In progression the sole shows advancing muscular waves. The lips, tentacles and eye-stalks offer no peculiarities. Dorsal and facial furrows are undeveloped or very weak. Small right and left body-lobes are developed on the mantle. The genital orifice is some distance behind the tentacle, but seems nearer that than to the mantle, in alcoholic examples. It is decidedly further back than in *Helicidæ*.

Pallial Organs.—They resemble those of *Amastra* and *Ena*. The surface of the lung is usually intensely black pigmented. It is macroscopically plain, without visible mesh of arteries and veins, only the pulmonary vein being visible. The kidney is very narrow and long, prolonged ureter-like forward nearly to the collar, where it opens by a pore on the intestinal side. A narrow fleshy ridge runs from the apex backward a short distance on the intestinal side. Pl. 20, fig. 3, *Partulina dolei*.

The jaw, when present, is excessively thin and delicate. It is composed of narrow, more or less overlapping, vertical elements, which seem completely united. They do not converge towards the middle (pl. 14, fig, 3, *A. lorata*). In some other species no jaw could be isolated. There seemed to be merely cuticle like that of the lower margin of the oral aperture.

The radula is short and broad. It bears V-shaped rows of teeth. These teeth are very numerous (150 in a half-row, in *A. lorata nobilis*), all the side teeth are alike, and of a peculiar shape which may be called *rastriform*, or rake-like; the basal-plate being narrow and long, widening anteriorly, where it is recurved, the reflection being broad, bearing 5 to 7 denticles or delicate, acute cusps, which are unequal, the lateral cusps being largest. In some species there is a narrow "central" tooth having a narrow bicuspid or tricuspid reflection. In others a central seems to be wanting, or if present is not

distinguishable from the marginal teeth. We believe that the narrow central, when present, is merely a modified marginal tooth, and not homologous with the central tooth of normal radulæ. These characters are shown in pl. 20, fig. 2, *A. lorata nobilis,* a tooth in profile at *x,* and pl. 20, fig. 1, *A. vulpina.*

The forms of the teeth are almost exactly similar in many species of *Achatinella, Achatinellastrum, Bulimella, Partulina, Eburnella, Perdicella, Baldwinia* and *Newcombia,* examined by Mr. W. G. Binney, H. M. Gwatkin, H. Suter and the writer.

The salivary glands are united above, and less broadly below the oesophagus, which is long and not dilated to form a crop. The stomach is long, cylindric, produced at the pyloric end. The intestine is long. As usual, the alimentary canal lies in four folds.

Reproductive organs (plates 12, 13, 14).—The terminal male organs are drawn isolated in pl. 13, fig. 4. The penis (*p.*) branches into a long appendix (*app.*) which is enlarged a little towards the distal end, more at the proximal end, and is very slender in the middle. The penial retractor muscle (*p. r.*) is bifid, one branch being inserted at the apex of the penis, the other on the enlarged basal part of the appendix. The vas deferens is terminal on the penis, and lies free from the uterus. There is no flagellum. The vagina is extremely short. Spermatheca globular, lodged among the caeca of the prostate gland, in which it is more or less completely imbedded (see pl. 13, fig. 3, right side). Its duct is very long, and not branched. The uterus is narrow below, but usually much enlarged above. It usually contains but one embryo in an advanced stage at a time (see pl. 13, fig. 3, the embryo showing through the transparent wall of the uterus).

The ovotestis is imbedded in the uppermost part of the digestive gland. The albumen gland is very minute (pl. 12, fig. 1, *a. gl.*), and in some species could not be found. The prostate gland is enormously developed, consisting of a large mass of long tubules (drawn on the left in figures 2, 5, 6, of plate 12).

The embryo usually attains about 3½ whorls before birth. Its shell is perforate, with the columella callused and obliquely truncate, or with a convex columellar lobe. The columellar lamella appears later. In *Partulina* the shell is finely engraved spirally, in *Achatinella* either more minutely engraved or smooth.

Free muscles.—The *retractor penis* attaches distally to the lung floor (not to the uterus as stated by Mr. Binney). The retractor muscles of the tentacles are free from the tail retractor or columellar muscle. Both divide anteriorly into three branches, ocular, tentacular and anterior pedal. One of the ocular bands passes between male and female branches of the genitalia. The pharyngeal retractor unites with one of the tentacular bands at about the posterior fourth of the latter. It is deeply bifurcate anteriorly (pl. 20, fig. 4, *Partulina dolei*).

On account of the uniformity of the soft anatomy in *Achatinellidæ*, no special descriptions are given under the generic heads. Characters in the soft parts to distinguish *Newcombia, Partulina, Achatinella* or any of the subordinate groups from one another, have not been found.

The first *Achatinella* to be dissected was *A. bulimoides*. The radula was described and the teeth figured by Heynemann in Malakozoologische Blätter, XIV, 1867, p. 149, pl. 1, figs. 2, 2*a*. Dr. Heynemann remarks on the astonishing similarity of the teeth to those of *Janella* (*Athoracophorus*).

In 1873, Mr. W. G. Binney dissected a considerable number of species, including the groups *Achatinella, Bulimella, Achatinellastrum, Partulina, Amastra, Laminella, Leptachatina,* figuring the teeth of several species and the genitalia of *A. producta.* (Annals of the Lyceum of Natural History of N. Y., X, pl. 15.) In Annals of the N. Y. Acad. Sciences, iii, p. 96, pl. 3, 6, and 16, 1884, Mr. Binney reviewed his work, figuring the teeth of ten species, including *Carelia,* and the jaws of *Carelia, Amastra* and *Laminella.*

In 1877 (Jahrbücher d. d. Malak. Gesellschaft, p. 330), Dr. G. Pfeffer gave an excellent account of the soft anatomy of *A. vulpina.* He corrected various errors in Binney's work,

but failed to recognize the nature of the retractor muscle of the appendix.

Mr. H. M. Gwatkin, in Proc. A. N. S. Phila., 1895, p. 238, gives the results of his examinations of the teeth of 20 species of *Achatinella* and *Partulina,* six of *Amastra,* and one each of *Leptachatina* and *Laminella.* In the same volume, p. 239, Mr. H. Suter describes the teeth of *A. cookei, lyonsiana,* and *Part. dolei,* and the teeth and jaws of two *Amastræ,* figuring those of *Ach. dolei* and *Amastra rubicunda.*

In Proc. A. N. S. Phila., for 1900, p. 565, the senior writer described and figured the soft anatomy of *A. dolei,* pointing out the significance of the Achatinellid organization.

The figures represent the following species:

PLATE 12, figs. 1, 2, *Achatinella abbreviata.* Northwestern Palolo. *A. gl.,* albumen gland; *fl.,* appendix; *r. p.,* retractor muscle of the penis.

Fig. 3, *Achatinella stewartii.* Northwestern Palolo. Male organs and atrium only.

Fig. 4, *Achatinella viridans.* Nuuanu. Male organs.

Fig. 5, *Achatinella byronii.* Waimano-Manana ridge.

Fig. 6, *Achatinella lila.* Waimano-Manana ridge.

PLATE 13, fig. 1, *Achatinella simulans* Rve. Waolani. *Sp.,* spermathecal duct; *v. d.,* vas deferens. The specimen is not gravid, uterus therefore small.

Fig. 2, *Achatinella lorata nobilis* Rve.

Fig. 3, *Achatinella mustelina.* Popouwela. *App.,* appendix; other letters as above.

Fig. 4, *Achatinella vulpina.* Glen Ada. Male organs.

PLATE 14, fig. 1. Embryo of *Pauahia tantilla.* Line on left 1 mm. long.

Fig. 2, *Partulina redfieldi kamaloensis.* Lettering as above.

Fig. 3, *Achatinella lorata.* Jaw.

Fig. 4, *Newcombia philippiana. ut.,* uterus, containing one embryo.

Fig. 5, *Partulina confusa.* The minute, slender albumen gland is seen above the proximal end of the hermaphrodite duct.

Family AMASTRIDÆ Pilsbry.

Amastridæ Pils., Manual of Conch., xx, p. viii, 1910.—*Amastrinæ* Pils., vol. xxi, p. xx.

Orthurethra similar to *Achatinellidæ*, *Tornatellinidæ* and *Ferussacidæ* in pallial organs. Reproductive organs as in *Achatinellidæ* except that the penial retractor muscle is simple, inserted on the penis *at the base of the appendix.* The appendix is conspicuously enlarged distally; the albumen gland is well developed, and the duct of the spermatheca is short.

Jaw well developed, vertically striate, plaited or ribbed. Radula oblong, distinctly divided into central, lateral and marginal areas by differences in shape of the teeth, as usual in land snails. Teeth in approximately straight, transverse rows; centrals narrower than the laterals, with one or three cusps; laterals bicuspid, the basal plate quadrate; marginals having the cusps more or less split.

Shell varying from discoidal and openly umbilicate to ovate, turrited or subcylindric, with the axis umbilicate, perforate or imperforate; usually having a columellar lamella in the last whorl, but never a parietal lamella or palatal plicæ.

Animal externally similar to *Achatinellidæ*, etc. External genital opening is nearer to the mantle than to the eye peduncle. Oviparous or viviparous. Mainly living on the ground, sometimes (the genus *Laminella*) on plants.

The differences in teeth, jaw and reproductive organs are certainly sufficient to distinguish this group as a family distinct from the *Achatinellidæ*. Having found constant differences in several unrelated organs, in a large number of species dissected, I have reconsidered my former opinion (vol. XXI, p. xx) that the Amastroid genera form a subfamily of the *Achatinellidæ*. The differences are far more fundamental than those separating many families of mollusks, and there seem to be no forms whatever, among the many which have been dissected, which are in any way transitional. The shells are much more alike than the soft parts, and this external

similarity has no doubt influenced the prevalent classification to an undue extent.

The distinction of *Amastridæ* of the subfamily *Leptachatininæ* from the *Ferussacidæ* is a difficult matter so far as the shells are concerned. The pallial organs, teeth and male reproductive organs are also similar; but the peculiar development of the prostate gland in *Amastridæ* is a perfectly tangible and important differential character, which I overlooked when discussing the question in Vol. XIX, p. 212.

Several genera of *Ferussacidæ* reach back to the Eocene, in species not materially differing from the recent forms; so that they must have been differentiated during Mesozoic time. It is obvious that in such groups as *Cochlicopa* and *Leptachatina* we have to do with very old stocks, which have changed with extreme slowness. It is a fair inference that the shell of *Leptachatina* is not greatly changed from the ancestral mesozoic or earlier stock which gave rise to the *Ferussacidæ, Amastridæ, Achatinellidæ, Enidæ*, etc.

Soft Anatomy of Amastridæ.

The animal is externally similar to *Achatinella* except that the genital orifice is further back, near the mantle (*Amastra, Carelia, Laminella*). The pallial organs are also substantially the same, except that the kidney is dilated laterally at the base, and therefore triangular in the lower part. (*Carelia turricula,* pl. 20, fig. 5.) The kidneys of several species of *Amastra* and *Laminella* do not differ materially.

The jaw is strong, arcuate, and usually irregularly "striated" vertically. In *Leptachatina* (pl. 21, fig. 10, *L. labiata*) it appears that the striation is caused by superficial overlapping edges of very narrow vertical plates, which are firmly united, as in the *Bulimulidæ*. In *Amastra* and *Carelia turricula* the jaw is very opaque and appears nearly or quite smooth. *Carelia bicolor* is figured and described by Mr. Binney as with "ten stout ribs, denticulating either margin." Similar variation from smooth to ribless occurs in several genera of *Helicidæ*. The jaw of *Laminella* is like that of *Amastra*. The radula is oblong, teeth not very numerous, in

approximately straight transverse rows. The central tooth is always much narrower than the laterals, and bears a single short cusp which is probably functionless. This is similar to the *Achatinidæ*, a family which differs fundamentally in other characters, such as the pallial organs and genitalia.

In *Carelia, Amastra* and *Laminella gravida* the laterals are of the usual quadrate form, with two cusps. The marginal teeth have two cusps, or the ectocone may be split into two or rarely more denticles. Pl. 21, fig. 6, *Carelia turricula* has 1, 22, 24 teeth. Pl. 21, figs. 1, 2, 3, *Amastra gravida.* Pl. 21, fig. 4, *Amastra spirizona.*

Laminella citrina has four or five denticles on the marginals (pl. 21, fig. 8), the teeth otherwise as in *Amastra.*

Pterodiscus rex, pl. 21, fig. 7, has 1, 9, 17 teeth in a half row. Like those of *Amastra,* the marginals have several denticles.

In *Leptachatina* the marginals are multi-denticulate by splitting of the ectocone, and on the outer ones the mesocone is also split. Pl. 21, fig. 5, *L. labiata.* Pl. 21, figs. 9, 11, *L.* (*Thaanumia*) *fuscula.* The number of teeth is rather small. *L. labiata* having, 1, 11, 23 in a half row, *L. fuscula* 1, 9, 18, and *Pauahia chrysallis* 1, 6, 12 teeth, the marginals with five or six denticles.

The reproductive organs are almost identical in general structure in the species of *Carelia, Amastra, Pterodiscus* and *Laminella* which have been examined. The penial retractor is invariably simple, inserted at the origin of the appendix, not the apex of the penis as in the *Achatinellidæ.* The appendix is always more swollen distally than in *Achatinellidæ.* The spermathecal duct is short, not long as in *Achatinellidæ.* There is a well-developed albumen gland, and the digitate prostate gland is nearly as large as in *Achatinella.* All of these genera are viviparous, usually carrying several young in the uterus. In *Carelia turricula* the embryo shell may be 12 mm. long, of 4½ whorls before birth. In *Amastra* the comparative length of the appendix varies widely. Thus, it is 50 mm. long in *A. pullata subnigra,* 13 mm. in *A. aurostoma.*

In *Amastrella flavescens* (Hawaii), *A. badia* (Oahu), *Cy-*

clamastra cyclostoma (Kauai), *Amastra magna* and *aurostoma* (Lanai), and *Paramastra turritella* (Oahu), the appendix is moderate in length, about twice as long as the spermatheca and duct. *Laminella* and *Pterodiscus* have the same proportions. This is probably the more primitive condition, as it agrees also with *Leptachatina.*

In a few other species examined, the appendix is extremely long. In *Paramastra cylindrica* (Waianae Mts.) it is 22 mm. long, five times the length of the spermatheca and duct, the terminal enlargement being nearly half the total length.

Amastra pullata subnigra is rather different. The appendix is 50 mm. long, about 8 times the length of spermatheca and duct, and its terminal enlargement is short. This is the greatest development of the appendix in the *Amastridæ* or *Achatinellidæ.* The *pullata* group is highly specialized in both appendix and the sculpture of the embryonic shell.

It is believed that a comparative study of the appendix will assist materially in the classification of the *Amastra. Amastra* and *Leptachatina* are the largest and most varied genera of the family.

The genitalia of the following species are represented on the plates.

PLATE 15, fig. 1, *Laminella gravida.* Tantalus Bowl. Male organs, showing the penis extruded.

Fig. 2, *L. gravida.* Nuuanu.

Fig. 3, *Laminella tetrao.* Lanai. Upper female organs omitted.

Fig. 4, *L. gravida.* Tantalus Bowl. Upper female organs omitted.

Fig. 5, *Laminella venusta.*

PLATE 16, fig. 1, *Amastra pullata subnigra. App.,* appendix; *p.,* penis; *r. p.,* retractor muscle of the penis; *sp.,* spermatheca; *ut.,* uterus.

Fig. 2, *Amastra turritella.* Male organs.

Fig. 3, *Amastra turritella.* Another specimen.

Fig. 4, *Pterodiscus rex.* Terminal ducts.

Fig. 5, *Amastra badia.*

Fig. 6, *Amastra aurostoma.*

Fig. 7, *Pterodiscus rex.* Male organs and atrium.

Plate 17, fig. 2, *Amastra cyclostoma.* Kauai.

Fig. 4, *Carelia turricula* Migh. Kauai.

Fig. 6, *Amastra spirizona.* Popouwela.

Fig. 7, *Amastra flavescens.* Glenwood, Hawaii.

Leptachatina resembles *Amastra* closely in genitalia, except that the spermatheca duct is longer, though not so long as in *Achatinella.* Its basal third is enlarged, and the spermatheca is globular. It is, however, not much more than half as long as the appendix.

L. ventulus (Fér.), pl. 17, fig. 3.

L. corneola (Pfr.), Halawa, Oahu. Pl. 17, fig. 1.

L. attenuata Cooke, Haleieie, Kauai. Pl. 17, fig. 5, penis.

Amastridæ are much more abundant as fossils than the *Achatinellidæ*, being found in all pleistocene deposits containing land shells, often in prodigious numbers. The extinct species of *Leptachatina, Amastra* and *Carelia* are somewhat numerous.

The classification of *Amastridæ* is given on pp. xx, xxi, of Vol. XXI. *Leptachatina* and *Amastra* are the two really distinct primitive stocks, the other groups being satellites of these, and evidently derived from them. Recognizing this, Professor T. D. A. Cockerell proposed to classify the genera in two tribes, *Leptachatinini* and *Amastrini* (*Science,* 1913, p. 256). These groups may be retained as subfamilies, the *Leptachatininæ* containing the genera *Leptachatina, Pauahia* and provisionally *Fernandezia,* the *Amastrinæ* comprising *Armsia, Planamastra, Pterodiscus, Amastra, Carelia* and *Laminella.*

Family TORNATELLINIDÆ Pilsbry.

Tornatellinidæ Pils., Nautilus, xxiii, p. 122, March, 1910.

Orthurethra with a very long, narrow kidney without differentiated ureter. Respiratory surface of the lung plain. Genitalia of Achatinellid type, except that the appendix has no retractor muscle; the penial retractor being simple and inserted at the distal end of the penis; jaw and teeth as in *Achatinellidæ*, the teeth being rastriform, in oblique, V-shaped rows.

The shell is small, *glossy,* longer than wide, globose, ovate or conic, perforate or closed, *the aperture armed with a parietal lamella* and usually one or two columellar lamellæ or folds.

Distribution: Islands of the Pacific and Indian Oceans.

This family is related, by its rudimentary albumen gland and highly developed, multifid prostate gland to the *Amastridæ* and *Achatinellidæ*.

In the pallial organs *Auriculella* and *Tornatellaria* closely resemble the *Achatinellidæ*. The lung is very long, not visibly veined, the mantle over it largely opaque white, with or without black stripes (*Auriculella*), or clear, spotted with white (*Tornatellaria*). Kidney very long, band-like; the short pericardium at its base (*Auriculella pulchra*).

The genitalia are intermediate in character between *Achatinellidæ* and *Amastridæ*; the spermatheca is lodged close to the prostate gland, and has a long duct, as in the former family, and the penial retractor is simple, attached to the penis only, as in the *Amastridæ*, though the attachment is apical, as in *Achatinellidæ*. The appendix is shorter than in either family, not exceeding the penis much in length, and it is not enlarged distally. The vas deferens and retractor are inserted at the distal end of the penis, the retractor being inserted distally on the lung floor. An eye-retractor passes between the branches of the genitalia.

Pl. 22, fig. 2, genitalia of *Auriculella pulchra,* Waimano-Manana ridge, Oahu. *App.,* appendix; *h. d.,* hermaphrodite duct; *p.* penis; *p. r.,* retractor of penis; *sp.,* spermatheca;

sp. d., duct of spermatheca; *vag.*, vagina. Fig. 1, opposite side of the penis of same. Fig. 3, penis of *Auriculella cerea* Pfr. Molokai. Fig. 6, genitalia of *Auriculella westerlundiana* Anc. Glenwood, Hawaii. Figs. 4, 5, living animals of *Auriculella castanea*, Mt. Tantalus. The markings on the mantle show through the shell.

The radula is like that of *Achatinellidæ*, having lost all central and lateral teeth, marginal teeth alone remaining (*cf.* Vol. XXII, pp. x, xi).

A further relationship with the two families mentioned is seen in the shell, which both by its general form, and by the fold, sinuosity or oblique truncation of the columella, is a good deal alike in the three families. The *Tornatellinidæ* differ from the others in having *a parietal lamella*, which no Achatinellid or Amastrid snail has. In this feature the *Tornatellinidæ* resemble most *Pupillidæ*, and are remarkably similar to the genus *Leptinaria* in the *Achatinidæ*.

The foot, when the animal is in movement, is about as long as the shell in *Auriculella* but decidedly shorter in *Tornatellina*. It is quite narrow, and in progression shows muscular waves, as in *Helicidæ* and many other snails (pl. 22, fig. 4). The sole often becomes areolate, when the animal is not moving, as though the muscles were contracted in large, irregular, vertical bundles. This has been noticed in both *Auriculella* and *Tornatellides macromphala*. In *Auriculella* the eye peduncles are bulbous at the ends, as usual in land snails, but in *Tornatellides* they are not enlarged distally.

Snails of this family are always small. In most of them the shell is three to five mm. long; but some species of *Auriculella* reach a length of 10 or 11 mm., being larger than some Leptachatinas. The largest species of *Tornatellina* are slightly longer than the smallest Auriculellas.

The *Tornatellinidæ* might, from their wide distinction, be thought ancestral to the very local *Achatinellidæ* and *Amastridæ*; yet it does not seem possible that the simple, generalized radula of *Amastridæ* could have been derived from the very-highly modified radula of *Tornatellinidæ*. And so far as the shell is concerned, the *Achatinellidæ* are nearer to

Amastridæ than either is to *Tornatellinidæ*. We conclude that the three families, while interrelated, are all very old, and probably descended from an ancient extinct family, more generalized than either, and related to the *Pupillidæ* (including *Enidæ*) and *Ferussacidæ*, differing however by the structure of the prostate gland.

Habits and Stations of Tornatellinidæ.

The following notes, brought together by the junior author, relate to Hawaiian forms, but no doubt most of the data apply equally well to those of other islands. The higher mountain slopes of the Hawaiian Islands offer an almost unlimited field of study to the painstaking collector of small or minute species of land Mollusca. This region, especially on Oahu, Molokai and Lanai, has been pretty well covered for the larger arboreal species (*Achatinellidæ*), but in what is known to the average collector as "small trash" (such as *Tornatellina*), it is practically an unexplored country.

Auriculella.—All the *Auriculella* are arboreal. They are all also oviparous. They are usually found on the leaves of ferns, shrubs and trees, though a few of the species seem to prefer the twigs and branches. This genus also contains practically all the species of the family which are particolored.

In the mountains about Honolulu, *A. auricula* is found on the leaves of all sorts of plants. *A. diaphana* is usually taken on the *ki* (*Cordyline terminalis*) in the axils of the leaves, but, where it is especially abundant, does not seem to be particular as to the kind of plant it lives on. *A. perversa* is usually found on the stems or branches of small trees or shrubs. *A. serrula* is only found near the crest of the main mountain ridge of Oahu. It seems to prefer the leaves of low-growing *lehua* (*Metrosideros polymorpha*). On Konahuanui, *A. turritella* is usually found on the lower pinnæ of a fern (*Sadleria pallida*).

Elasmias.—The species of this genus are usually found on the leaves of trees, shrubs and ferns. They are rarely taken on the branches or trunks except during rain. For such small snails they are remarkably rapid in their movements. All

the Hawaiian species are ovoviviparous. When cleaning the shells nearly every adult animal contains from 2 to 4 embryos in different stages of development. There is a great similarity between the adult stage of *Elasmias* and very young stages of *Auriculella*.

The Hawaiian species of this genus are separated by the presence or absence of palatal folds and the form and size of the columellar callus.

E. fusca has been found in Hawaii, East and West Maui, Molokai, and Lanai; *E. luakahaensis* on Oahu and Kauai; *E. anceyana* has so far only been collected only on West Maui.

TORNATELLINA.—Species of this genus have been taken from about sea-level to nearly 5,000 ft. elevation. As far as we know, *T. baldwini* is strictly arboreal, being found on the leaves of shrubs and ferns. *T. lanceolata* is sometimes arboreal, as a few of the specimens in the collection have been taken in the leaf-axils of the ki, but most of the specimens were found on the ground on the dead leaves of the ieie. *T. cylindrica* is found only on the trunks of trees (especially the lehua) under loose bark, moss or lichens. *T. oblonga* is usually terrestrial in its station. It is especially fond of dead leaves, though occasionally taken on trunks of trees a foot or two from the ground, and sometimes on old stone walls. *T. gracilis* is strictly terrestrial in habit. All the specimens which I have taken were under stones in very dry localities and not far from the sea.

Distribution.—T. baldwini has been found on Kauai, Oahu, E. Maui and Hawaii. It probably occurs on most of the other islands. *T. peponum* and *mcgregori* are only found on Hawaii. *T. gayi* is peculiar to Kauai. *T. oblonga* has been found on all the islands except Kahoolawe and Niihau. *T. cylindrica* has been reported from Kauai, Oahu and Molokai. *T. lanceolata* has been found only on Oahu. *T. polygnampta* occurs on East Maui and Molokai. *T. gracilis* has been found alive on Oahu and Kauai. Fossil specimens of this species have been found on all the islands except Niihau and Lanai, which have not been searched.

Kauai has 4 species of *Tornatellina,* of which one is peculiar

to that island. Oahu has 5 species, one of which is peculiar. Molokai has 4 species, of which none is peculiar. Lanai has only the widely-spread species, *T. oblonga.* Maui has 4 species, only one of which, *T. polygnampta*, extends to the neighboring Island of Molokai. Kahoolawe has only the widely-spread *T. gracilis;* and Hawaii has 5 species, two of which are peculiar.

TORNATELLIDES.—The species of this genus are found from about sea-level to nearly 8,000 ft. elevation, or as far up as there is any vegetation. Some of the species are arboreal in habit, especially those belonging to the group of *T. compacta,* of which all the species, though sometimes found on dead leaves, are usually taken on the leaves of ferns, grass and shrubs. The species belonging to the group of *T. perkinsi* are usually found on dead leaves and twigs, and specimens are occasionally taken on low plants. Practically all of the species belonging to the group of *T. terebra* are terrestrial in habit. The only two living species of the group of *T. cyphostyla* were taken on the trunks and branches of trees and shrubs. The species belonging to the groups of *T. euryomphala* and *T. thaanumi* are not only terrestrial but also live on the stems and leaves of ferns, grasses and shrubs.

TORNATELLARIA.—All the species of this genus are strictly terrestrial in habit, being found on dead leaves and twigs, fallen logs and mossy stones. Occasionally a specimen is taken on a damp, mossy tree-trunk a foot or two from the ground. The living species seem to prefer rather damp localities. Fossil specimens are found in localities which are extremely dry at the present time.

Distribution of Hawaiian genera and species.

The numbers in parenthesis indicate the number of species limited to a single island.

	Kauai	Oahu	Molokai	Lanai	Maui	Kahoolawe	Hawaii	No. of species
Auriculella	2? (0?)	19 (19)	5 (5)	1 (1)	3 (3)	.....	1 (1)	29
Elasmias	1 (0)	1 (0)	1 (0)	1 (0)	2 (1)	.....	1 (0)	3
Tornatellina	5 (1)	5 (1)	4 (0)	1 (0)	4 (0)	1 (0)	5 (2)	9
Gulickia	.....	.....	.....	.....	1 (1)	.....	.....	1
Waimea	.....	.....	.....	.....	.....	.....	1 (1)	1
Tornatellides	5 (3)	13 (9)	5 (1)	4 (0)	11 (7)	2 (1)	10 (6)	32
Tornatellaria	1 (0)	2 (1)	4 (1)	1 (0)	5 (3)	.....	5 (4)	13
Totals	14 (4)	40 (30)	19 (7)	8 (1)	26 (15)	3 (1)	23 (14)	88

Genus AURICULELLA Pfeiffer.

Auriculella Pfr., Proc. Zool. Soc. London, 1855, p. 1, for *Helix auricula* Fér., *Tornatellina petitiana* Pfr., *Partula pusilla* Gld.(?), *Achatinella* (*Auriculella*) *cerea* Pfr.; Monographia Heliceorum Viventium, viii, 1877.—Pease, Journ. de Conchyl., 1868, p. 342; P. Z. S. Lond., 1869, p. 649.—*Frickella* Pfr., Proc. Zool. Soc. Lond., 1855, p. 2, monotype *A. amoena* Pfr.—*Trickella* Pfr., Nevill, Handlist Ind. Mus., 1878, p. 159.

The shell is oblong-conic or ovate-pyramidal, perforate or closed; the internal axis is slender, imperforate, unarmed except in the last whorl; surface highly polished; aperture ovate, the outer lip somewhat expanding, blunt, usually thickened; there is a well-developed parietal lamella and often one or two columellar lamellæ or folds, the latter always present in the young stages. Animal oviparous, the eye-tentacles swollen at their tips.

Type *A. auricula* (Fér.). Distribution, Hawaiian Islands (except Niihau, Kauai and Kahoolawe); station, on bushes and other plants.

The first species known, *A. auricula,* was placed by Férussac in *Partula,* where it was retained by von Martens as late as 1860. Chamisso described a species as *Auricula.* Pfeiffer, in his earlier writings, described various Auriculellas as *Tornatellina* and *Balea,* and he originally proposed *Auriculella* and *Frickella* as sections of *Achatinella.*

Pease, in 1869, was the first author to rank *Auriculella* as a

genus. Gulick, in 1873, seems to have followed him; but Pfeiffer did not use *Auriculella* in a generic sense until 1877.

Pease recognized 11 species in 1868; Pfeiffer, 18 in 1877; Ancey, 24 (Bul. Soc. Malac. France, VI, 1889, pp. 211-235), and Sykes (in Fauna Hawaiiensis, II, Moll., pp. 375-379), 20 species.

Distribution.—Of the 30 species of this genus, recognized in this monograph, 19 are from Oahu, 5 from Molokai, 3 from Maui and one each from Lanai and Hawaii. Kauai is without a described species at present, though there are three lots in the collection of the Bishop Museum from this island. Two of these lots, each containing a single specimen, are undoubtedly *A. auricula*. They are probably the result of a more or less recent introduction. The third lot consist of two or three adult specimens and several immature. All of these closely approach *A. diaphana,* and, until more material has been collected, are referred to this species. Except for the two species mentioned above, no one species has been found on more than a single island. The species which have been reported from more than one island by earlier authors have not been carefully determined.

Specific characters.—Most of the species are rimate when adult, but in all the axis is imperforate when immature. Nearly all of the thicker species have numerous color forms, but most of the thin species are unicolorous. The color-patterns (which are made up of white, yellow and different shades of brown) usually take the form of revolving bands and lines. In only a few cases are the shells longitudinally striped. When this is so the patterns are not distinct, and are made up of brown and brownish-corneous.

The peristome is always more or less thickened in adult specimens. In the thinner species it is usually a slightly darker shade than the shell, but in the thicker multicolored species it may be either white or very dark. In adult Auriculellas from Oahu the columella is furnished with one or two folds. Most of the species from the islands east of Oahu have a simple unarmed columella. The columella of *all immature specimens* is furnished with one or two folds.

The parietal wall is always furnished with a lamella. In most species this lamella is rather high in front, then descends rather rapidly, and is continued in back as a raised line. In a single species (*A. serrula*) the parietal lamella is serrated, with sharp, outward projecting spines. In a very few species a basal palatal fold is present. This fold sometimes persists in the adult stage, but usually disappears at about the time the shell reaches maturity. Most of the species are either uniformly dextral or sinistral, but in a few the direction of coil is indifferently dextral or sinistral, often among individuals of the same colony.

Key to Species of Oahu.

I. Form ovate-conic, the oblique diameter about half the length of the shell or more (rarely less, in which case the shell is conspicuously opaque); *whorls of the spire but slightly convex;* columella usually having one fold.

a. Columella having a distinct fold or lamella; length 6 to 12 mm., with 5½ whorls *or more.* GROUP OF A. AURICULA.

b. Shell thin, sinistral; lip thin, not in the least thickened outwardly or within; color in browns, not yellow; 5½-6½ whorls. *diaphana,* no. 1.

*b*¹. Shell opaque or with yellow coloring; lip slightly or very much thickened within; more than 6 whorls. Either dextral or sinistral.

c. Outer lip "duplicate," accompanied by an external ridge or keel; a transverse tubercle at the posterior angle of the aperture.

d. A rounded ridge behind lip; very solid, narrowly umbilicate, malleate, not glossy, the oblique diameter a little less than half the length. *malleata,* no. 9.

*d*¹. Lip-ridge angular; shell wider.

e. Adult nearly or quite imperforate. *ambusta,* no. 8.

*e*¹. Distinctly umbilicate, glossy. *pulchra,* no. 7.

c^1. Outer lip blunt but not duplicate; perforate or umbilicate.

d. Rather small, less than 9 mm. long.

e. Diameter half the length; uniform yellow, thin. *straminea,* no. 2.

e^1. Diameter more than half the length; yellow or variegated. *auricula,* no. 3.

d^1. Larger, usually over 10 mm. long; solid, opaque.

e. Yellow, nearly uniform or with a cinnamon spire; distinctly striate. *olivacea,* no. 5.

e^1. Yellow with brown band. *amoena,* no. 4.

e^2. Last whorl opaque white or marked with brown. *montana,* no. 6.

a^1. Columella edentulous or having an obtuse median fold; whorls of the spire strongly convex; length 4 to 5 mm., with 5 to 6 whorls. GROUP OF A. PERPUSILLA.

b. Shell sinistral.

c. Broadly ovate, ventricose, length 4.5 mm. *perversa,* no. 11.

c^1. Ovate, smaller, length 4 mm. *perpusilla,* no. 12.

b^1. Shell dextral. *minuta,* no. 10.

II. Form high, the length twice or more than twice the oblique diameter; shell and lip thin; columella biplicate, at least in the immature stages. GROUP OF A. CASTANEA.

a. Shell perforate or umbilicate.

b. Shell dextral; length 8 mm. *chamissoi,* no. 18.

b^1. Shell sinistral.

c. Cinnamon with paler streaks, 8 to 9 mm. long, with 8½ whorls. *tenuis,* no. 19.

d. Length about 6 mm., with 6½ to 7 whorls.

e. Parietal lamella small; umbilicus moderate; Waianae Mts. *tenella,* no. 20.

e^1. Parietal lamella well developed, perforation small; eastern. *tantalus,* no. 17.

a^1. Shell imperforate, the columellar margin appressed.

b. Shell dextral. *turritella,* no. 13.

b^1. Shell sinistral.

c. Parietal lamella minutely spinose. *serrula,* no. 14.

c^1. Parietal lamella smooth.

d. Length 8 mm., with 8 whorls. *castanea,* no. 15.

d^1. Length 6.3 mm., with 8 whorls. *petitiana,* no. 16.

Three species described by Pfeiffer, *A. amœna, A. chamissoi* and *A. petitiana,* have not been recognized with certainty by modern collectors. It is not known positively that the last two are from Oahu.

Group of A. auricula.

The shell is usually solid, rarely translucent, perforate, or rarely imperforate (when imperforate, the umbilicus is closed with the thickening of the columellar lip). The oblique diameter is about half or more than half of the length. Spire conic or a little convexly conic, composed of flattened or but slightly convex whorls. Columella usually unidentate, often with posterior minute fold deep within. Lip usually thickened, expanded, sometimes duplicate, rarely thin. In the young the shell is imperforate, angulate at the periphery; without palatal plicae, the columellar fold strong, nearly transverse, with an acute edge.

This group comprises the bright-colored or white species, and a few with dull coloring. The shells are larger than in the group of *A. perpusilla,* with more whorls, which are nearly flat.

The two Waianaean species, *malleata* and *ambusta,* are well characterized, and in the East, *A. diaphana* is unmistakably distinct, also *A. straminea,* which however stands near *auricula.* The rest of the species—*A. auricula, olivacea, montana, amœna* and *pulchra* form a complex of interrelated forms in which "species" are distinguished with difficulty. The distinction made in the key between species with "duplicate" lip and those with it "blunt, not duplicate" is rather

a matter of degree as between *pulchra* and the five species following. Old specimens of *auricula, montana,* etc., have an incipient and inconspicuous development of the "duplicate" structure.

1. A. DIAPHANA Smith. Pl. 27, figs. 1 to 6.

"Shell sinistral, ovately conic, very thin, corneous, striped with brown, obscurely encircled at the middle of the last whorl by a brown band; whorls 5½, slightly convex; suture simple; lip thin, slightly dilated; columella scarcely plicate, sometimes reflexed, forming a small umbilical cleft, joined to the lip by a thin callus; parietal lamella thin. Length 7, diam. 4 mm." (*Smith*).

Var. "Shell unicolorous". (*Sm.*)

Oahu: Olomana, Kailua, Palolo, Kalihi (Gulick), Makiki (Gulick, Cooke, Pilsbry), Tantalus (Perkins, Cooke, Pilsbry), Pauoa (Perkins, A. A. Heller).

Auriculella diaphana SMITH, P. Z. S. Lond., 1873, p. 87, pl. 10, fig. 25.—PFR., Mon. Hel. Viv., viii, p. 209.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 219.—SYKES, Fauna Hawaiiensis, Moll., p. 376.

"It is like *Aur. tenuis* Smith, in structure, and like *Aur. auricula* Fér. in form. The latter species, however, is usually dextral, while this is almost always sinistral." (*Smith.*)

A large series of about 600 specimens, agreeing closely with the above description, was collected by the authors at the head of Makiki Valley, and others around Tantalus, where it is an abundant snail. All the specimens are remarkably constant in form and texture, and all are sinistral. Twenty-five examples taken at random were carefully measured and have an average length and diameter of 7.05 x 3.96 mm. The largest specimen was 7.7 x 4.0 mm., the smallest 6.6 x 3.7 mm., and the mean variation from the average length was only 0.2 mm.

The common color-varieties are: (*a*) unicolorous dark reddish brown; (*b*) corneous with broad indistinct stripes of a slightly brownish corneous; (*c*) corneous with a narrow light colored band bordered above and below by narrow dark

bands; (*d*) corneous with narrow dark brown band; (*e*) dark reddish brown with a narrow or broad yellowish corneous band. It never has the opaque texture of *A. auricula.*

1*a*. *A. diaphana cacuminis* P. & C., n. subsp. Pl. 24, figs. 11, 12.

Very much larger than *A. diaphana,* but similar to that in its thin texture; exquisitely glossy, ochraceous-tawny with a chestnut peripheral band (sometimes wanting), but also varying to uniform chestnut-brown or to colonial-buff. Aperture some tint of vinaceous within, the thin edge of the well-expanded lip being pale. Length 9.6, oblique diameter 5 mm.; 6½ whorls.

Oahu: "Mauna Kope," at the head of the Kalihi-Moanalua ridge (Thaanum).

This case falls in with many others noted in our volume on *Achatinellidæ*, where eastern species extend their range west of Nuuanu valley, in noticeably modified races, upon the peaks of the mountain axis. The efficiency of Nuuanu as a barrier to the spread of the mountain tree-snails was much less in former times.

2. A. STRAMINEA Cooke, n. sp. Pl. 24, fig. 13.

The shell is perforate and rimate, dextral, elongately conic, pale chalcedony yellow, fading towards the apex, and more opaque, almost straw yellow near the lip; thin, imperfectly diaphanous, glossy, under a lens very minutely striate with lines of growth. Spire long conic, apex obtuse. Suture scarcely impressed, faintly margined. Whorls 6¼, nearly flat, the last rather narrow, elongate, ascending slightly to the aperture, somewhat tapering towards the very convex base. Aperture irregularly ovate, slightly oblique and diagonal. Parietal lamella rather small, slightly oblique. Columella simple, with a small, nearly horizontal lamella. Lip expanded, slightly thickened within, the outer margin convex, the columellar margin reflexed; parietal callous thin, with a short thickening near the posterior angle. Umbilical groove rather long. Length 7.6, oblique diam. 3.7 mm.

Oahu: Mt. Tantalus (Cooke).

This species differs from *A. auricula* in its much more elongately conic form, thinner shell, shape of aperture, etc. It has some, probably superficial, resemblance to *A. tenella* Anc. The mantle is white, irregularly mottled with narrow, nearly black patches. No sinistral specimens have been found in over two hundred individuals examined. A few specimens have a slightly brownish spire. The average measurements of 8 adult specimens are: Length 7.6, diam. 3.9 mm.

3. A. AURICULA (Férussac). Pl. 24, figs. 1 to 10.

"Shell ovately acute, imperforate, slightly thickened, somewhat striate, yellowish; spire conical, apex obtuse. Whorls 5, contiguous, the last ventricose, subcarinate. Aperture subquadrangular; lip acute, thickened within, with flexuous outer margin; columella unidentate. Furnished, in the depth of the aperture, with an elevated strongly marked lamella. Length 3, diam 1¾ lines (6.8 x 4.0 mm.)." (*Fér.*)

Hab. Oahu: Tantalus (Perkins, Cooke), Nuuanu, Pauoa and Palolo (Cooke). Also westward north of the main range.

Partula auricula FÉRUSSAC, Prod., 1821, p. 66, no. 6; QUOY and GAIMARD, Voy. autour du Monde, Uranie et Psysicienne, Zool., p. 468.—SOULEYET, Voy. de la Bonite, Zool., ii, 1852, p. 511, pl. 29, figs. 9-11.—PFEIFFER, Conchyl. Cab., Partula, p. 277.—REEVE, Conch. Icon., Partula, no. 18.—*Bulimus auricula* PFEIFFER, Mon. Hel. Viv., ii, 1848, p. 75.—*Achatinella* (*Auriculella*) *auricula* PFEIFFER, P. Z. S. London, 1855, p. 1; Mon. Hel. Viv., iv, p. 569; vi, p. 187.—*Auriculella auricula* PEASE, P. Z. S. London, 1869, p. 649.—PFEIFFER, Mon. Hel. Viv., viii, p. 209.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 211.—SYKES, Fauna Hawaiiensis, ii, Moll., p. 375.—*Auricula owaihiensis* CHAMISSO, Nov. Act. Soc. Leop., xiv, 1829, p. 639, pl. 36, fig. 1.—KUESTER, Conchyl. Cab., *Auriculacea*, 1844, p. 26, pl. 3, figs. 14-16.—*Auricula sinistrorsa* CHAMISSO, Nov. Act. Soc. Leop., xiv, 1829, p. 640, pl. 36, fig. 2.—KUESTER, Conchyl. Cab., *Auriculacea*, 1844, p. 48, pl. 7, figs. 14-16.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 213.—*Partula dumartroyii* SOULEYET, Revue Zoologique, 1842, p. 102.—*Bulimus armatus* MIGHELS,

Proc. Bost. Soc., ii, 1845, p. 19.—*Auriculella armata* Ancey, Bull. Soc. Malac. France, vi, 1889, p. 213.—*Auriculella patula* Smith, P. Z. S. London, 1873, p. 88, pl. 10, fig. 24.—Ancey, Bull. Soc. Malac. France, vi, 1889, p. 215.—*Auriculella perkinsi* Sykes, Fauna Hawaiiensis ii, Moll., p. 377, pl. 11, figs. 17, 18.—*Auriculella triplicata* Pease, Journ. de Conchyl., 1868, p. 346.

This species varies greatly in form, size and color. The typical form (or rather the form which comes nearest to Férussac's description) is from Pauoa, just back of Honolulu. *A. perkinsi* is slightly larger and more solid than the Pauoa shells, but in form and color-pattern agrees closely with the typical *auricula.*

The largest adult specimen measured 9.5 x 4.8 mm., the smallest 6.5 x 4.1 mm. Most of the specimens are perforate.

Bulimus armatus Migh. was undoubtedly from Oahu, as the columellar fold is present; not from Hawaii as he states.

The color-variety figured as *A. dumartroyi* by Souleyet is rather characteristic. This color-variety, with a very broad light band, is only found in the upper part of Nuuanu and Tantalus. From the known localities of other species collected during the voyage of the *Bonite,* there is no doubt that this shell came from Nuuanu, though the measurements are rather large for a shell from this locality.

A. triplicata Pease is a rather broad form of this species. The deep duplication of the columella is often found in typical specimens of *auricula.* Pease's specimens undoubtedly came from Palolo Valley.

The young of this and the allied species are imperforate, angular at the periphery of the last whorl, and the columellar fold is strongly developed, rather thin and nearly horizontal; there are no palatal plicæ.

The different colonies of *A. auricula,* from Nuuanu, are very interesting. They differ from one another considerably. Some colonies are entirely dextral, while in one only 12 per cent are dextral, the others with varying percents all the way between. Each colony is remarkably constant in its proportions of length to breadth. Usually some one color-var-

iety predominates in each colony, and a few of the color-varieties are limited to single colonies. Most of the color-varieties are found in nearly all the colonies, though occasionally one or more are absent. The colonies from the western side of Nuuanu have sometimes a small tubercle at the junction of the outer lip, but this character is entirely absent in the shells from the eastern side and also the Pauoa shells.

The most common color-varieties are: (*a*) brown with a slightly darker spire; (*b*) unicolorous brown; (*c*) light brown striped with a darker shade; (*d*) brown with a narrow white band at the periphery; (*e*) brown with a very broad whitish band; (*f*) chestnut with a narrow white band bordered above and below by two narrow dark brown bands; (*g*) yellowish white with a very narrow brownish band; (*h*) brownish with a broad dark brown band; (*i*) light brown with a narrow dark brown band and slightly different shades of yellow. The lip is dark brown, light purplish brown or white.

A. pulchra and *A. montana* are closely related to *A. auricula,* and there are colonies which seem to contain both *auricula* and *pulchra* as well as some specimens which are difficult to decide upon. Yet throughout nearly all of the range of *pulchra* (from the western Nuuanu ridge westward, on the southern slopes of the range) there are no true *auricula* whatever.

The undescribed form named *A. pellucida* by Gulick (Evolution, Racial and Habitudinal, p. 220, 1905) is straw yellow (varying to naphthaline yellow) with white sutural line, the spire paler or cinnamon, or rarely the whole shell is cinnamon. Most of the specimens have no callous in the posterior angle of the aperture, but when present it is very small. The expanded lip is not thickened or "duplicate"; length about 7 mm. This form has the characters of *A. auricula* (and in fact can be exactly matched in Palolo *auricula*), but it is in the territory of *A. pulchra.* It comes from Kaliuwaa (pl. 24, fig. 10), Punaluu and Hauula (Gulick coll. in A. N. S. P., no. 92503, etc., and in Bishop Mus.).

Length 7.8, oblique diameter 4 mm.

Length 7.3, oblique diameter 4 mm.

4. A. AMŒNA (Pfr.), Vol. XXII, pl. 30, fig. 3.

"Shell subperforate, ovately oblong, thin, slightly striate, glossy, yellow, obscurely banded with a brown band; spire convexly conical, apex slightly obtuse; suture impressed; whorls 6½, slightly convex, the last nearly equal to 3-7 of the length, slightly attenuate at the base; aperture oblique, semioval; parietal lamella subtransverse; columellar fold subduplicate, calloused, a spiral lamina superposed; lip simple, unexpanded. Length 11½, diam. 5 mm." (*Pfr.*)

Sandwich Islands (Frick); Oahu: Halemano (Perkins).

Achatinella amœna Pfr., P. Z. S. Lond., 1855, p. 2, pl. 30, fig. 3; Mon. Hel. Viv., iv, p. 569; vi, p. 187; viii, p. 233.—*Frickella amœna* Pfr., SYKES, Fauna Hawaiiensis, ii, Moll., p. 379.—*Auriculella* (section *Frickella*) *amœna* GULICK, P. Z. S. Lond., 1873, p. 91.—*Auriculella amœna* HARTMAN, Proc. A. N. S. Phila., 1888, p. 14.

This shell is more or less related to *A. montana*. It differs chiefly in its more elongately oval spire, size, etc.

Probably the type is not quite mature, as the lip is thin. There is no necessity of considering *amœna* as forming a special genus or section, as it is closely allied to other species of the group of *A. auricula*. The original figure was reproduced photographically in Vol. XXII, pl. 30, fig. 3.

5. A. OLIVACEA Cooke, n. sp. Pl. 27, figs. 10, 11.

The shell is perforate-umbilicate, dextral, ovately conical, rather solid; the last whorl is amber yellow, the rest brown shading into the lighter color on the penultimate whorl, inside of the umbilical region white, a narrow white band accompanies the suture. The surface is glossy, distinctly striate. Spire conic, apex slightly obtuse. Suture slightly margined, scarcely impressed. Whorls 6¾, nearly flat, the last rotund, slightly elongate, convexly tapering at the base. Aperture hardly oblique, nearly ovate, slightly diagonal. Parietal lamella rather small, nearly vertical. Columella simple, thickened, with a rather small lamella. Lip expanded,

thickened, the outer margin arcuate, bordered on the outside with white, the columellar margin reflexed over the umbilicus and connected with the outer margin by a rather thick greenish-white callus. Umbilicus large for the genus, nearly circular. Length 11, diam. 5.6 mm.

Oahu: Mt. Olympus, at an elevation of about 2,500 feet (Kuhns, Cooke); Konahuanui, at an elevation of 3,300 feet (Kuhns, Spalding).

The large size, distinct though fine striæ, greenish color, etc., at once separate this species from any other. All the specimens agree very closely in shape, size of umbilicus, etc. Some of them have a lighter colored spire, only a shade darker than the last whorl. The average length and diameter of four adult specimens are 10.5 mm. long, 5.4 mm. diameter.

This species differs from *Auric. montana* in color, form of spire, size of umbilicus, texture of the surface, etc. From *A. pulchra* it differs in size, form of aperture, the lip simply expanded, not beveled or duplicate, the color and the more distinct striation.

6. A. MONTANA Cooke, n. sp. Pl. 27, fig. 9.

The shell is perforate, dextral (rarely sinistral); ovate; with the spire cream-buff or ivory-yellow, the last whorl opaque white; solid, glossy, under a lens very finely striate with lines of growth. Spire conic with the outlines barely convex; apex small. Suture simple, slightly impressed. Whorls 6½, slightly convex, the last long, ovate, with tapering base, somewhat flattened dorsally. Aperture white, auriform, not oblique, very slightly diagonal. Parietal lamella rather thin, rather small, vertical. Columella thickened with a rather small, almost horizontal thin lamella. Lip thickened, the outer margin sinuously thickened, the lower spreading, the columellar margin reflexed over the umbilicus. The columella and outer lip are united by a rather thick, smooth callus, with a transverse tubercle at the juncture. Umbilicus ovate. Length 10.1, diam. 5.3 mm.

Oahu: Mt. Konahuanui (Cooke).

Variety, pl. 24, fig. 14; pl. 27, figs. 7, 8. Slightly more

elongate, spire chestnut brown, last whorl having indistinct cinnamon streaks on a much lighter ground. Lip, columella, and callus deep chocolate, parietal and columellar lamellæ lighter. Length 9.7, diam. 4.9 mm.

Oahu: Lanihuli (Cooke).

This species might be confused with *A. pulchra,* of which it may perhaps be a variety. It differs in that the last whorl is more elongate and slightly flattened, *the base less saccate.*

Of the type form, I have 31 specimens before me which range from 9 to 10.4 mm. in length, and from 4.9 to 5.2 mm. in breadth. The color-pattern is the same in all the specimens. Only one specimen is sinistral.

Of the variety, out of 38 adult specimens (of which five are sinistral), 21 specimens have the dark lip, etc.; 7 approach the typical color-pattern except that the first three whorls are darker colored.

This species has only been found on two of the higher peaks of the main mountain range of Oahu, from about 2,000 to 3,000 feet. It is not abundant in either of the two localities.

7. A. PULCHRA Pease. Pl. 23, figs. 5 to 20.

"The shell is solid, ovate, dextral, perforate, longitudinally striate; whorls 6, flatly convex, the last subinflated; suture impressed, aperture subauriform; lip thickened, reflexed, expanded, with the margins united by a thick callus; parietal lamella prominent; columella reflexed above the umbilicus; with a thick fold; white, encircled by a greenish band, lip brownish. Length 10, diam. 6 mm." (*Pease.*)

"Var. Pale straw-color, lip white." (*Pease.*)

Oahu: Western ridge of Nuuanu (Cooke, Pilsbry); Maunakope (Thaanum) Halawa and Koneleau ridge near summit (Thaanum); Waimano-Manana ridge at summit (Spalding, Pilsbry); Waiawa, Kalaikoa, Ahonui, Wahiawa, Helemano, Kawailoa, Opaeula, Pupukea, Waialee (Gulick); Poamoho (Thaanum); on the north side at Kahaluu and Hakipuu (Gulick), and Kaliuwaa (Thaanum).

Auriculella pulchra PEASE, Journ. de Conchyl., xvi, 1868, p. 346, pl. 14, fig. 6.—PFR., Mon. Hel. Viv., viii, p. 212.—

Hartman, Proc. Acad. N. S. Phila., 1888, p. 15.—Ancey, Bull. Soc. Malac. France, vi, 1889, p. 214.—Sykes, Fauna Hawaiiensis, ii, p. 378.—*Auriculella solida* Gulick, Bland, Ann. Lyc. N. H. of N. Y., x, 1874, p. 332 (name only).

We have examined the specimens in Pease's collection at Cambridge and those presented to the Academy of Natural Sciences of Philadelphia, most of them belonging to Pease's variety only; the coloration described as typical being rather rare. The figure in the Journal de Conchyliologie represents the "pale straw-colored" variety. The typical coloring as shown by a Pease specimen (pl. 23, fig. 5) is white with a broad grape-green zone above the periphery, changing on the penultimate whorl to brown, the summit being deep brown. There is a border of the white ground below the suture, ascending the spire, and a small brown area around the umbilicus. Other specimens of the Pease lot have the last whorl and summit and peristome cinnamon, intervening whorls very dark with a very narrow white sutural margin (pl. 23, fig. 6), or the whole shell may be marguerite yellow or sea-foam yellow, this being Pease's variety. Of 14 specimens seen from Pease, 3 are sinistral. None of these shells equals Pease's measurements, the largest being 9 mm. long, 4.6 in oblique diameter.

The shell is very much like *A. auricula,* but differs by being more solid, usually larger, and by having a strong tubercle at the posterior end of the parietal callus, connecting with the end of the outer lip. The lip is beveled in the upper half, from an angulation or keel running parallel with its edge. The width of the bevel varies in different colonies, being narrow in the east, but often wider, with a more pronounced keel, in the yellow western form which Gulick called *solida.* The lower half of the peristome has an obtuse rounded edge. The latter part of the last whorl is often quite noticeably flattened peripherally, and the base is sack-like. It may be either dextral or sinistral. In one lot from high in Waolani there are 26 dextral and 35 sinistral individuals.

The Waianae species *mallcata* and *ambusta,* and particularly *A. ambusta obliqua,* differ from *pulchra* by the narrower

or closed umbilicus. The crest behind the lip is more emphatic than in most *pulchra*.

The color-patterns of Pease's specimens noted above are of usual occurrence in Waolani valley, from rather low down to the peak, where the shells are rather larger—up to 9 mm. long, which is near enough to Pease's measurement. As Waolani is readily accessible from Honolulu—being one of the nearer little glens of the western wall of the superb Nuuanu valley—we select upper Waolani valley including the valley flank of Waolani Peak as the type locality. Here the species is abundant on leaves of shrubs along the trail.

Besides the color-varieties mentioned above there are white shells, naples or maize yellow, or greenish above the periphery; buff-pink or cinnamon shells with the spire of the same tint or lighter, the peristome white, or spire slate color, the lip and parietal wall chestnut-brown. Also many combinations, shades and tints of all of these patterns. We have added to the figures of Pease specimens (pl. 23, figs. 5, 6), others from Waolani collected by one of us (pl. 23, figs. 8-13).

Most of the specimens in Mr. Gulick's collection were labeled *A. solida* Gk., a name which has appeared in print, but has never been defined in any way, probably because Gulick recognized its identity with *pulchra*. He collected great numbers in many of the western valleys.

Low in Waolani valley the average size is smaller than higher up, though larger individuals also occur. Several measure:

Length 7.8, oblique diameter 4.5 mm.; 6 whorls.

Length 6.6, oblique diameter 3.7 mm.; 5½ whorls.

Length 7.2, oblique diameter 3.6 mm.; 6⅓ whorls.

A. pulchra ranges from the northwestern end of the main range to Nuuanu valley. The greatest variety of colors is found southeastward. Many colonies westward have but one or two patterns.

Maunakope. White, with the spire either slightly russet, greenish-yellow, dark brown or blue; peristome usually dark. Figs. 14, 15.

Halawa. Yellow above, white below the periphery; white with slate or greenish spire. Fig. 16.

Summit Waimano-Manana ridge. Uniform yellow, or with the spire slate or vinaceous rufous; in the latter case sometimes having a peripheral band of the same color. Found in ieie axils. Figs. 17-19.

Waiawa; Ahonui, also Opaeula. Dark olive-buff, becoming white on the back and base, spire sometimes rufous; peristome white.

Kalaikoa; Wahiawa. Similar to preceding, or cinnamon or tawny olive, spire light or dark; peristome white. These are like two of the common Waolani patterns.

Poamoho. Like figs. 9, 20, 13, or rarely with a rufous peripheral band.

Helemano (fig. 20), *Kawailoa, Waialee, Pupukea.* Amber yellow with white sutural line and white peristome.

On the *north side of the main range,* the specimens from Hakipuu and Kaliuwaa are yellow, with white sutural line. Those from Kahaluu are plain yellow, white, or cinnamon (the base a little lighter), or the spire is cinnamon, last whorl white with a cinnamon band.

The localities " Kaala and Mt. Tantalus (Perkins) " are doubtful, the first certainly erroneous, probably based upon a specimen of *A. ambusta obliqua.*

The range of *pulchra* eastward is still rather indefinite. From the western ridge of Nuuanu and westward, *A. auricula* is not found; but some specimens not distinguishable from *pulchra* are found in the *A. auricula* territory. Thus at the base of the eastern ridge of Nuuanu, in the Luakaha district, opposite the reservoir, the authors found a few *pulchra* among the much more numerous *A. auricula.* A Kalihi series from the Gulick collection is clearly *pulchra.* The shell is white with yellowish spire, or greenish yellow above the periphery, the tubercle in the angle well developed. Even among Gulick's Palolo *auricula,* one can find some individuals with the characters of *pulchra.* Yet as a general rule, only *auricula* is found east of Nuuanu.

8. A. AMBUSTA Pease. Pl. 23, figs. 1, 2.

" Shell solid, imperforate, conically ovate, sinistral " [or

dextral], "distinctly longitudinally striate; whorls 6, flatly convex; suture impressed; apex obtuse. Aperture subauriform, vertical; lip thickened, duplicate, parietal lamella somewhat thin; columellar fold thick, twisted, high; pale purplish white, base burnt umber, covered with a brown, deciduous epidermis. Length 8½, diam. 5 mm." (*Pease*).

Oahu: Waianae Mts. (Baldwin, Lyman); Palikea (Spalding); Popouwela (Thaanum).

Auriculella ambusta Pease, Journ. de Conchyl., 1868, xvi, p. 345.—Pfr., Mon. Hel. Viv., viii, p. 211.—Ancey, Bull. Soc. Malac. France, vi, 1899, p. 214.—Sykes, Fauna Hawaiiensis, ii, p. 375.—*Auriculella obliqua* Ancey, Mem. Soc. Zool. France, v, 1892, p. 721.—Sykes, Proc. Malac. Soc. London, iii, p. 275, pl. 13, fig. 17.—Fauna Hawaiiensis, ii, p. 377.

This peculiar species is rather limited in its distribution as it has only been found near the middle of the Waianae Mountain range.

Pease described his shell as imperforate, but a careful examination showed that most of his shells have a minute perforation, which is sometimes closed by the thickening of the lip, or perhaps always in old shells. The keel-like ridge behind the lip, giving it a duplicated appearance, *continues on the base.* This is unlike *A. pulchra,* in which the ridge approximates to the basal edge, though prominent behind the outer lip. In *A. malleata* also, the ridge does not continue to the base, and its crest is rounded, not keeled or angular as in *ambusta.* The apical whorl is yellow, whitish or bluish-black, spire delft blue (lighter or darker), often brown above the suture, or it may be nearly white or pale yellow, becoming white on the upper part of the last whorl; lower part of the last whorl brown (cinnamon to amber brown), usually more or less covered with a deciduous blackish epidermis, which gives the scorched appearance signalized by the very apt name *ambustus.* The interior is dark below in many specimens, and there is a short transverse callus at the posterior end of the peristome. A sharp ridge runs outside the outer lip. Length 7.6, oblique diameter 4.5, aperture 4 mm. It turns either way. In one lot from Popouwela there are 9 dextral and 7 sinistral individuals.

8a. *A. ambusta obliqua* Ancey. Pl. 23, figs. 3, 4.

No formal description of *A. obliqua* has been published, but Mr. Ancey has given the following notes: "Mr. Baldwin has made the remark that there are in Oahu two species not inhabiting the same districts, both called by the name *auricula* Férussac. I therefore propose the new name of *obliqua* for those that are almost always sinistral, of a uniform white or yellowish color, having the spire quite short, but chiefly remarkable for the great obliquity of its strongly thickened peristome, angular in the middle, and having a characteristic sinuosity at this point. The base of the aperture recedes strongly, and the peristome is very patulous at the lower extremity" (*Ancey*).

Oahu, in the Waianae range: Lihue (Gulick); Western ridge of Popouwela, abundant (Spalding, Cooke & Pilsbry); Mokuleia (Gulick).

Ancey's type has been figured by Mr. Sykes, and is now contained in the Bishop Museum at Honolulu, and some of the same lot, from Mr. Baldwin, are in coll. A. N. S. P. It is white or straw-yellow, usually with some short cinnamon streaks, faint or distinct, on the flattened periphery of the last half whorl. In some of the specimens from Lihue (fig. 4) these streaks are quite conspicuous. In others from Popouwela they are frequently wanting altogether; but none in a series of several hundred has any of the dull blackish epidermis characteristic of *A. ambusta.* This, and the slightly more lengthened shape are the sole peculiarities distinguishing the subspecies from *A. ambusta.* The same form had been named by Gulick, but his name never appeared in print, to our knowledge.

9. A. MALLEATA Ancey. Pl. 27, figs. 12, 13, 14.

"The shell is solid, perforate, oblong conoidal, glossy, opaque, white, usually with a reddish or brownish, sometimes white, apex; sinistral; under a lens subimpressed with light lines of growth. Spire somewhat elongate, convexly conoidal, apex minute, somewhat acute. Whorls 6½ to 7, the first slightly convex, the rest flat, very often malleate with a

few elevated wrinkles descending forwardly like many Limnæas. Aperture subauriform, angulate above, spreading and receding below, oblique, furnished with a quite thin or moderate parietal lamella and with a not prominent, slightly obtuse, sometimes indistinctly duplicate columellar lamella. Lip thickened, expanded at the base, exteriorly margined, with the margins joined by a callus bearing a tubercle or swelling at the juncture, flattened further down, and slightly carried forward in the middle. Length 9, diam. 4.25; alt. ap. (oblique) 4.5 mm.'' (*Ancey*).

Oahu: Summit of Mt. Kaala, in the Waianae Mts. (Thwing, Cooke).

Auriculella malleata ANCEY, Proc. Malac. Soc. London, vi, 1904, p. 120, pl. 7, fig. 12.

''Related to *A. obliqua* Ancey found on Oahu, but much more slender, malleated, and tinged with brown on the earlier whorls'' (*Anc.*).

This is a very distinct species and is not abundant in any locality. The forwardly-descending malleation is very distinct in some of the specimens. The small umbilicus appears acutely ovate from below. The shape is narrower, more oblong than in the allied Waianaean species *A. ambusta*. So far as known it is always white, very solid, with the outlines of the spire slightly convex and the summit perceptibly nipple-like. There is a *low swelling* or rounded ridge behind the outer lip, but *not a sharp ridge* such as *malleata, obliqua* and *pulchra* have. Usual size 8.8 mm. long, 4 mm. in oblique diameter. A form of *ambusta* is sometimes slightly malleate.

Group of A. perpusilla.

The shell is small, perforate, thin, more or less translucent, composed of few (less than 6) *convex* whorls; lip expanded, but very slightly thickened. Columella straight or having an obtuse median fold.

The young are imperforate, obliquely angled at the periphery; columella with a rather strong, transverse, thin fold.

Three species, in the main range of Oahu. The strong convexity of the whorls of the spire distinguishes these species from the preceding and following groups.

10. A. MINUTA C. & P., n. sp. Pl. 25, figs. 5 to 9.

Shell narrowly perforate, dextral, ovately conic; the last whorl is cartridge buff with some faint cinnamon streaks, shading to cinnamon on the spire, thin, slightly translucent, glossy, under a lens minutely striate with lines of growth. Spire conic, apex obtuse. Suture slightly impressed, marginate. Whorls 5¾, slightly convex, the last rotund, subsaccate at the base. Aperture irregularly ovate. Parietal lamella small, thin, whitish, standing at an angle of about 45 degrees with the axis. Columella edentulous, slightly twisted. Lip thin, slightly expanded, outer margin convex, columellar margin reflexed and nearly adnate. Umbilicus narrow, subrimate. Length 4.8, diam. 3.7 mm.

Oahu: Nuuanu (Cooke), Palolo (Lyman, Cooke).

This shell is closely related to *A. perpusilla*. It differs, however, in its more elongate and conic form, less convex whorls and much narrower umbilicus; it is always dextral, or at least in more than 700 examples no sinistral specimens have been found. There are six color varieties found in Nuuanu, viz.: (*a*) the corneous type color; (*b*) unicolorous dark chestnut; (*c*) dark chestnut with a broad white band at the periphery of the last whorl and extending under the suture of the penultimate whorl; (*d*) corneous with a rather narrow dark band at the periphery of the last whorl; (*e*) light chestnut with a similar band at the periphery and (*f*) a darker chestnut similarly banded, with a light base and the dorsal surface of the last whorl dark chestnut.

The shells from Palolo are all unicolorous, corneous.

11. A. PERVERSA Cooke, n. sp. Pl. 25, figs. 3, 4.

The shell is minutely perforate, sinistral, broadly ovate, unicolorous, dark chestnut, thin, slightly translucent, under a lens minutely striate with lines of growth. Spire conic, the summit obtuse, apex minute, pale. Suture impressed, narrowly margined. Whorls 5½, convex, the last ventricose, saccate at the base. Aperture slightly oblique, diagonal, irregularly ovate. Columella with a minute fold deep within, and (under a lens) with a very minute, thin, perpendicular fold

near the outer margin of the columella extending to the inner margin of the lip, at the base of the columella. Lip rather thin, expanded, the outer margin curved, the columellar margin reflexed over the umbilicus, the margins united by a thin, transparent callus. Umbilicus minute, subcircular. Length 4.5, diam. 3.0 mm.

Immature specimens have a rather prominent transverse columellar fold, and the perpendicular fold on the face of the columella is absent.

Oahu: Nuuanu (Cooke); Kuliouou (Thaanum).

This species is closely related to *A. perpusilla* Sm. It has a slightly larger shell, with the last whorl more tumid. The shell is slightly thicker. The columellar fold is slightly more distinct and with the presence of the additional perpendicular fold easily separate the two species. This outer fold is rather hard to make out as it is very minute. *A. perversa* differs from *A. minuta* by the sinistral coil and the vertical fold mentioned. It is also usually wider.

The specimens from Kuliouou are a shade darker and slightly smaller, 4.4 mm. long.

12. A. PERPUSILLA Smith. Pl. 25, figs. 1, 2.

"Shell minute, sinistral, shortly ovate-conic, perforate, fragile, corneous. Whorls 5, somewhat convex; suture simple; aperture subcircular; parietal lamina thin; lip thin, very slightly dilated; columella scarcely plicate, somewhat reflexed. Length nearly 4, diam. 2.66 mm." (*Smith*).

Oahu: Kahalu (Gulick); Kahana (Lyman, Kuhns); Kaliuwaa (Judd); Kaaawa (Spalding, Kuhns).

Auriculella perpusilla SMITH, P. Z. S., Lond., 1873, p. 87, pl. 10, fig. 26.—PFEIFFER, Mon. Hel. Viv., viii, p. 213.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 220.

The single specimen collected by Mr. Gulick and described by Mr. Smith, is unfortunately broken. There is enough remaining to make out the characters of the last whorl and aperture. The shells from Kahana collected by Mr. Lyman agree very closely with the type. They are multicolored, as follows: corneous; dark chestnut; corneous with a dark band at

the periphery of the last whorl; and dark chestnut with a white band on the last whorl. The shells from Kaaawa are a very pale tint of yellow, shading to cinnamon on the spire and sometimes near the lip.

Group of A. castanea.

The shell is at least twice as long as wide, usually imperforate, sometimes perforate; thin, sometimes slightly solid. Spire turrited or elongately conic. Lip thin or only very slightly thickened, but little expanded. Columella twisted, biplicate in the young, and usually in the adult stage, with the outer margin adnate or free.

In the young the shell is imperforate, carinate or angled at the periphery; the columellar lamella, developed on the lower part of the fold, is strongly developed, the fold itself less so, and more oblique.

One species, *A. tenella*, is found in the Waianae mountains, the others all in the main range.

13. A. TURRITELLA Cooke, n. sp. Pl. 25, fig. 15.

The shell is imperforate, dextral, turrited, elongate, chestnut, rather thin, semidiaphanous, not glossy, under a lens minutely and regularly striate with lines of growth. Spire elongately conic, apex somewhat obtuse. Suture scarcely impressed, marginate, dark chestnut. Whorls 9½, the embryonic rounded, the rest flat, slowly and regularly increasing, compact, the last somewhat rotund, subsaccate at the base. Aperture ovate, hardly oblique. Parietal lamella scarcely oblique, rather small, whitish. Palatal fold minute, transparent, elongate, deeply situated nearly midway between the columella and the periphery. Columella twisted, thickly callous, strongly biplicate, the upper lamella oblique, the lower slightly more developed, more horizontal, both extending to the margin of the lip. Lip rather thin, expanded, the outer margin slightly arcuate, the columellar margin reflexed, adnate. The margins are united by a very thin transparent, very minutely punctate callus. Length 8.6, diam. 3.6 mm.

The young of this species is decidedly angulate at the per-

iphery. The palatal fold is bifurcate near its beginning and more strongly developed than in the adult. There is sometimes an upper palatal fold, just above the periphery. The folds of the columella are strongly developed, especially the lower which is almost horizontal.

Oahu: Konahuanui, at an elevation of about 3,000 ft. (Lyman, Cooke).

There is a great deal of variation in the columella of the six adult specimens which I have before me. The columella in one specimen is hardly biplicate, while in another there are three distinct columellar folds.

This species somewhat resembles *A. castanea* Pfr. It differs from the latter by having flatter and more compact whorls, it is decidedly more turrited in form, besides being always dextral.

14. A. SERRULA Cooke, n. sp. Pl. 25, figs. 13, 14.

The shell is imperforate, sinistral, turrited, elongately conic, light chestnut corneous, thin, diaphanous, glossy, under a lens very minutely striate with lines of growth. Spire elongately conic, apex somewhat obtuse. Suture not impressed, very narrowly margined, slightly darker than the shell. Whorls 8½, the embryonic slightly rounded, the rest nearly flat, slowly increasing, rather compact, the last rotund, subsaccate at the base. Aperture nearly ovate, slightly oblique. Parietal lamella well developed, whitish, very slightly oblique, minutely serrate, being set with microscopic thorn-like spines, inclined a little towards the opening. Columella twisted, callous, biplicate. Columellar lamellae parallel, rounded, about equal in size and extending to the margin. Lip thin, unexpanded for the most part, but slightly expanded below, the outer margin slightly arcuate, the columellar margin reflexed, adnate. Length 6.2, diam. 2.8 mm.

The young are strongly angled at the periphery. The parietal lamella is slightly more strongly serrate than in the adult. There is a basal palatal fold as in *A. turritella,* but it is not bifurcate. This fold is set with minute spines, like the parietal lamella. It persists up to the end of the neanic stage, but is

absent in the adult. As in all related species the lower columellar lamella is the more strongly developed,

Oahu: Mt. Konahuanui, at about 3,000 feet (Cooke); Kuliouou (Thaanum).

In size this species approaches *A. tenella* Ancey. It differs in proportion of length to breadth, in its much thinner shell and in the serrate parietal lamella.

15. A. CASTANEA Pfr. Pl. 25, figs. 10, 11, 12.

"Shell sinistral, ovately turrited, somewhat solid, slightly striate, glossy, corneous chestnut, spire turrited, somewhat obtuse; suture impressed, marginate; whorls 8, somewhat flat, the last a little more than one-third of the length, carinate; parietal lamella strong, white, entering spirally; columella twisted above and callously thickened; aperture oblique, reversed auriform; lip unexpanded, external margin acute, columellar margin slightly thickened. Length 8, diam. 4 mm.; aperture 3 mm." (*Pfr.*).

Oahu: Moanalua and Nuuanu (Cooke); Tantalus (Perkins, Cooke, Pilsbry).

Tornatellina castanea PFR., Mon. Hel. Viv., iii, 1853, p. 524.—*Achatinella lurida* PFR., Mon. Hel. Viv., iv, p. 570; Mal. Blätt., 1846, p. 166.—*Leptinaria castanea* AD., Gen. Moll., ii, p. 140.—*Balea castanea t. c.*, p. 174.—*Auriculella lurida* PFR., Mon. Hel. Viv., viii, p. 213.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 228.—SYKES, Fauna Hawaiiensis, Moll., p. 376.—*Auriculella tenuis* SM., var. *solida* ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 230.—Not *Auriculella lurida* BORCH., Zoologica, part 48, p. 141, pl. 60, figs. 21, 21*a*, 22, 22*a* = *A. brunnea* Sm.

"Differs from *T. petitiana* in color, sculpture, carination, and not dentate columella. It appears to be more related to *T. sinistrorsa* Cham., but is sufficiently different in its turrited form" (*Pfr.*).

As already stated by Mr. Ancey, the type is not quite adult, as the outer lip is thin and unexpanded, and the last whorl is carinate. In adults the peristome is noticeably expanded and the periphery is rounded.

There is an oblique columellar fold and sometimes a lower obtuse callous lamella superposed upon it, and more prominent than the fold. In a few shells from the eastern side of Nuuanu, the parietal lamella forks near the outer edge—one branch normal in form and position, the other lower, thicker and rounded, is curved and extends nearly to the insertion of the columella. In some of the Nuuanu shells there is a weak, fine and close spiral sculpture on the base.

There are five color varieties of this species: the first and most abundant is the typical color, a corneous chestnut, streaked with a slightly lighter shade; the second is of a uniform corneous color; the third a uniform very dark chestnut; the fourth chestnut, with a very broad dark band at the periphery of the last whorl; and the fifth with a narrow white band at the periphery of the last whorl; this light band is sometimes margined, above and below, by two bands of a slightly darker shade than the ground color.

Mr. Borcherding, following Hartman's identification, gives Kahanui, Molokai as the habitat. From his figure, his shell seems to be a form of *A. brunnea* Smith. *A. castanea* has also been stated to be from Maui, on Mr. Baldwin's authority; but he confused this species with a chestnut variety of *A. uniplicata.*

16. A. PETITIANA (Pfeiffer). Pl. 28, fig. 8.

"Shell sinistral, conically turrited, smooth, glossy, pellucid, corneous; spire elongate, apex somewhat acute; suture narrowly margined; whorls 8, scarcely convex, the last nearly equal to one-third of the length, rotund at the base; parietal wall of the aperture furnished with a spirally entering, acute, elevated, white lamella; columella slightly twisted-dentate above; aperture oblique, semioval, thinly calloused with white within; lip acute. Length 6.3, diam. 3 mm.; aperture 2.25 mm. long" (*Pfr.*).

Habitat unknown.

Tornatellina petitiana PFR., Zeitschrift für Malak., 1847, p. 149.—KUESTER, Conchyl. Cab., *Tornatellina,* p. 153, pl. 18, figs. 24, 25.—*Achatinella petitiana* PFR., Mon. Hel. Viv., iv, p.

570.—*Helicteres petitiana* Pease, Journ. de Conchyl., 1868, p. 343.—*Auriculella petitiana* Pfr., Mon. Hel. Viv., viii, p. 210. —Ancey, Bull. Soc. Malac. France, vi, 1889, p. 227.—Sykes, Fauna Hawaiiensis, ii, Moll., p. 377.—Not *A. petitiana* Borcherding, Zoologica, part 48, p. 146, pl. 9, figs. 24, 24*a* (Kealia, Molokai) = a sinistral form of *A. cerea.*

The specimen in the British Museum under this name belongs to a different species, and no doubt is somewhat related to *A. cerea* Pfr. From an examination of Küster's figure and a comparison of the descriptions, *A. petitiana* seems to be very closely related to *A. castanea* Pfr. Pfeiffer, in a note on the latter species, compares the two. I have specimens that undoubtedly belong to *A. castanea* which are corneous in tint.

Pfeiffer does not state that his shell was umbilicate, and it may be inferred that it was imperforate. All the Tornatellinas known to him at that time were imperforate (*cf.* Monographia I, 1848, p. xxv). Kuester's figure, reproduced in pl. 28, fig. 8, gives the impression of an imperforate shell. Kuester says of the type specimen that there is a " weak whitish callous in the throat " and that "the columella ascends almost vertically, with a tooth-like prominent fold; the peristome straight, sharp". It was apparently not quite mature, though from the number of whorls (8) it must have been nearly so.

By the numerous, closely coiled whorls, the size and color, Pfeiffer's shell agrees with *A. serrula*; but that species has a strongly plicate and lamellate columella, and when not quite mature there is a lower-palatal plica, but no callus in the throat.

A. tantalus has part of the characters of *petitiana,* but it is distinctly perforate, and there are not whorls enough.

There is an imperforate species found on Mt. Tantalus, sometimes associated with *A. tantalus,* which it resembles in size, shape and often in color. It varies in one colony from chestnut-brown, through cinnamon of various shades and tints to naphthalene yellow with a cinnamon summit. There is a lower-palatal lamina in the neanic stage up to a length of about 4.4 mm., and the columellar lamella is very prominent

until the adult stage is reached, when it diminishes. It differs from *A. serrula* by the smaller number of whorls in the same length, and by having very few prickles on the parietal lamella or none at all.

17. A. TANTALUS Pilsbry & Cooke, n. sp. Pl. 24, figs. 15, 16.

The shell is sinistral, distinctly perforate, but the perforation does not extend deeper than the last whorl; very thin, somewhat glossy, rather distinctly striate; cinnamon-colored (or sometimes with the last two whorls naphthalene yellow), the thin cuticle rather subject to disintegration, producing whitish dots and spots. Apex rather obtuse. Whorls 6½, the first one convex and glossy, the rest very slightly convex, the last whorl very indistinctly subangular in front of the aperture, elsewhere rounded, the base rotund. Aperture of the usual shortly, irregularly-ovate shape, showing the external color within. The peristome is thin, very little expanded outwardly, more at the base; the columellar margin triangularly dilated, not appressed, but projecting forward in an obtuse angle, seen in a profile view. Parietal callus very thin. Parietal lamella high and thin. Columella vertical, very indistinctly biplicate and somewhat excavated below in a front view, but in an oblique view in the mouth the two folds are somewhat more distinct. A fine keel runs vertically on the face of the columella to its base.

Length 5.9, oblique diam. 2.8 mm.

Oahu: Pauoa side of Tantalus along the Castle trail (type loc., Cooke & Pilsbry); Nuuanu (Cooke).

This species is closely related to *A. tenella* Anc., of the Waianae range. It differs from that by having a decidedly larger parietal lamella, a smaller umbilicus and a somewhat different columella, as described above. The little keel or vertical rib on the face of the columella is much like that of *A. perversa.*

Specimens in the late neanic stage have a strong lamella on the columella, but no palatal fold or callous.

18. A. CHAMISSOI (Pfeiffer).

"Shell subperforate, oblong-pyramidal, somewhat solid, under a lens sculptured with spiral striæ, covered with a brown epidermis, obsoletely streaked. Spire elongately conic, slightly obtuse; whorls 7½, nearly flat, the last nearly equal to two-fifths of the length, somewhat compressed at the base; aperture scarcely oblique, auriform; parietal lamella strong, outwardly branched downwards; columellar fold small, somewhat twisted, white; lip whitish, slightly expanded. Length 8, diam. 3.5 mm.; aperture nearly 3 mm. long, 2 mm. wide below the middle" (*Pfr.*).

Oahu (Baldwin, Newcomb); Hawaii (Sykes); Sandwich Is. (Pfr., Mus. Cuming).

Achatinella (*Auriculella*) *chamissoi* PFR., P. Z. S. London, 1855, p. 98.—*Auriculella chamissoi* PFR., Mon. Hel. Viv., iv, p. 570; viii, 1877, p. 210.—NEVILL, Hand-List Moll. Ind. Mus., 1878, p. 159.—ANCEY, Bull. Soc. Mal. France, vi, 1889, p. 216.—SYKES, Fauna Hawaiiensis ii, p. 376.

Unfortunately, this species is unfigured. The single specimen in the British Museum appears to have the characters of an Oahuan shell. It is dextral, and seems to be somewhat distantly related to *A. tenella*. The branching of the parietal lamella is probably not constant or of specific importance, as several specimens of *A. castanea* Pfr., from Nuuanu possess this character. The alleged spiral striation is a peculiar feature for an *Auriculella*.

19. A. TENUIS Smith. Pl. 25, fig. 16.

"Shell sinistral, very elongately conic, slightly perforate, thin, somewhat diaphanous, lightly striate with lines of growth, brownish corneous, encircled by a pale band at the middle of the last whorl; whorls 8½, scarcely convex; apex somewhat obtuse; aperture small; lip very slightly dilated; parietal lamella somewhat thickened at the aperture; columellar fold doubled, lightly reflexed, joined to the lip by a very thin callus. Length 9, diam. 4 mm" (*Smith*).

"Var. A. Shell brownish corneous, unicolorous" (*Sm.*).

Oahu: Wahiawa, Helemano and Kawailoa (Gulick).

Auriculella tenuis SMITH, P. Z. S. Lond., 1873, p. 87, pl. 10, fig. 27.—PFEIFFER, Mon. Hel. Viv., viii, p. 213.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 280.

This shell is very closely related to *A. castanea* Pfr. It differs, however, in size, being more slender, slightly thinner, and in having a minute perforation. In the young 2.6 mm. long, and up to about three-fourths grown, the lower columellar lamella is very strongly developed. *A. tenuis* var. *solida* Anc. is *A. castanea* Pfr. This latter species is found in the southeastern portion of the main mountain range of Oahu, while the former is found towards the northwestern extremity of the same range. Probably forms connecting the two species may be found when the intermediate region has been sufficiently explored. Some immature specimens are before us from the summit of the Manana-Waimano ridge, taken from axils of ieie.

20. A. TENELLA Ancey. Pl. 19, figs. 7, 8.

"Shell sinistral, ovately conic, pellucid, very thin, reddish corneous or straw color indistinctly streaked with reddish corneous; perforate, glossy, under a lens obliquely slightly striated (except the somewhat obtuse apex). Spire regularly conic; whorls 7, regularly increasing, suture narrowly margined; the upper whorls more convex, the rest scarcely convex; the last larger, rotund, ascending slightly and for a long distance at the end. Aperture slightly oblique, scarcely thickened, nearly circular, emarginate above, with a minute lamella (lamella thin) on the ventral portion of the penultimate whorl, emarginate at the insertion of the columella. Columella obliquely twisted-plicate within, plica sometimes slightly bipartite, the upper part of the lip straight, then slightly expanded, broadly dilated at the margin of the columella, thin. Length 6, diam. 3, length of aperture 3.6 mm" (*Ancey*).

Oahu: Waianae Mts. (Baldwin, Cooke); Western ridge of Popouwela (Spalding, Cooke & Pilsbry).

Auriculella tenella ANC., Bull. Malac. France, vi, 1889, p. 232.

"This pretty species is related to *diaphana* Smith, and to

westerlundiana Ancey. It differs from the first, which comes from a different part of Oahu, by the smaller size, the larger number of whorls, its color, etc. It differs, likewise, from the second by its color, the larger number of whorls, especially by the shell being more slender, glossy, and other characters which a comparison of the descriptions sufficiently shows. *A. obeliscus* of Pfeiffer is closely related to *tenella*; they agree in the number of whorls, columella, and proportions; it differs in color, in its sharp apex, its simple suture, etc." (*Ancey*).

This is a rather rare species and one that is not found in many collections. I have collected a few specimens at Palehua, near the southeastern end of the Waianae Mts., and another small series back of Leilehua, at about the middle of the range; these two series agree very closely and present only very slight differences. It is abundant on the western ridge of Popouwela. I have only three color-varieties of this species in addition to the typical pattern (fig. 7); the first uniformly corneous; the second corneous with broad light chestnut streaks; the third a slightly darker shade of chestnut, with a narrow dark chestnut band at the periphery extending on the spire, and almost covered by the suture. Fig. 8 represents a whitish corneous specimen with cinnamon streaks and a chestnut brown band. It measures, length 6.5, oblique diam. 3 mm.

There is a rather small circular umbilicus, decidedly larger than in *A. tantalus*.

21. A. KUESTERI (Pfeiffer). Not figured.

Shell subperforate, ovate-turrite, rather solid, very lightly striate, subopaque, pale green. Spire regularly long-conic, the apex rather obtuse; suture linear, margined. Whorls 6, nearly flat, the last slightly exceeding two-fifths the total length, rounded at base. Aperture oblique, semioval, with a compressed, oblique deeply-entering parietal lamella; columella acutely toothed; peristome simple, acute, the columellar margin reflexed. Length 8, diam. 4; aperture 3.33 mm. (*Pfr.*)

Habitat unknown; described from the Cuming collection.

Tornatellina kusteri Pfr., Proc. Zool. Soc. Lond., 1854, p. 295; Monographia Hel. Viv., iv, p. 650.

A species not recognized by subsequent authors, which by its assigned size, color and apertural characters seems to be an Oahuan *Auriculella*. It is probably identical with some known species.

Group of A. cerea.

The shell is umbilicate, perforate or imperforate, from broadly ovate to attenuate, thin or solid. The columella is usually edentulous, rarely minutely dentate; but without a lamella at any stage of growth. Lip slightly thickened to strongly thickened. No palatal plicæ at any stage. In the young the shell is imperforate, angled, the lip thin. Columella twisted, usually with a minute, very oblique fold.

This group includes the shells from Molokai, Maui, Lanai and Hawaii. The very oblique minute columellar fold is constant in the young of all the species examined, but there is no superposed lamella.

Species of Molokai.

a. Shell rather thin.

b. Parietal callus thin throughout.

c. Length about 7 mm., with 7 whorls.
A. newcombi, no. 20.

*c*¹. Length about 5.5 to 6.5 mm.; yellow, 6 to 6½ whorls. *A. flavida*, no. 21.

*b*¹. Parietal callus thick at the edge.

c.¹ Length about 5.5 to 6.5 mm., 6 to 6½ whorls.
A. flavida, no. 21.

*c*¹. Length about 8.5 mm., with 8 whorls.
A. cerea, no. 22.

*a*¹. Shell decidedly solid, rather thick.

b. Imperforate, the columella not built forward; in oblique view *very indistinctly* bidentate deep within.
A. canalifera, no. 24.

*b*¹. Imperforate or umbilicate, the columella built forward in adults; in oblique view having an obtuse fold deep within. *A. brunnea*, no. 23.

20. A. NEWCOMBI (Pfeiffer). Pl. 28, figs. 1, 2, 3, 4.

"Shell sinistral, very shortly rimate, turrited, thin, slightly striate, glossy, pellueid, pale corneous; ornamented with a reddish band; spire elongate, aeute; whorls 7, nearly flat, the last nearly equal to one-third of the length, furnished in the parietal wall with an oblique lamella, rotund at the base; eolumella slightly twisted-plieate; aperture oblique, semioval; lip thin, slightly expanded, eolumellar margin dilated above, reflexed. Length 7, diam. 3 mm; aperture 2⅓ mm. long" (*Pfr.*).

Molokai (Neweomb in eoll. Cornell Univ.); Kalamaula (Perkins); Puunea, and northward to the pali (Cooke & Pilsbry).

Balea newcombi PFR., Proe. Zool. Soc. London, 1853, p. 67. —*Auriculella newcombi* SYKES, Fauna Hawaiiensis ii, p. 377. —Not of Borcherding, Zoologica, part 48², p. 139, pl. 9, figs. 17, 18.—*Achatinella obeliscus* PFR., Mon. Hel. Viv., iv. p. 570. —*Auriculella obeliscus* PFR., Mon. Hel. Viv., viii, p. 213.

I have seen the shells in the British Museum and in Newcomb's eolleetion. The species is distinet from any other and has some resemblance to *A. tenella* Aneey, from Oahu. The two are, however, easily separable. It is most nearly related to *A. cerea,* but that species is larger, with a strong parietal callus.

The figures purporting to be of this speeies in *Zoologica* represent a banded variety of *A. brunnea.* In the typieal forms of *A. newcombi* the basal outline is more truncate and the aperture more diagonal than in Boreherding's figures.

The Puunea shells vary from einnamon to ehamois, the lighter ones often indistinetly streaked with einnamon; and either color may be banded with ehestnut-brown or sometimes a darker shade of the body-color at the periphery. The base is very eonvex, the lip thin, and the parietal eallus is not thiekened at the edge—this and its somewhat thinner shell being the main distinctions from *A. cerea.* Length 6.8, oblique diam. 3.2 mm., with 7 whorls. All of the speeimens seen are sinistral.

21. A. FLAVIDA Cooke, n. sp. Pl. 26, figs. 8, 9.

The shell is minutely perforate, dextral or sinistral, ovately conic, naphthalene yellow, very thin, slightly diaphanous, glossy, under a lens minutely striate with lines of growth and with extremely fine revolving striæ. Spire conic, apex obtuse. Suture hardly impressed, simple. Whorls 6½, slightly convex, the embryonic rather large, rounded, the last rotund, saccate but slightly tapering below. Aperture broadly oval, scarcely oblique. Parietal lamella very small, white. Columella nearly straight. Lip very slightly thickened, the outer margin arcuate; the columellar margin is reflexed; parietal callus thin. Umbilicus moderate, rimate. Length, 6.2, diam. 3.1 mm.

In the young the shell is imperforate, the columella is simple, not dentate, slightly twisted.

Molokai: Kamalo (Thaanum, Pilsbry & Cooke).

This shell has the appearance of a small *A. cerea* Pfr. It differs considerably from the common forms of Pfeiffer's species in being much thinner and smaller, with a smaller umbilicus and *thin parietal callus.* It is closely related to *A. newcombi* Pfr., but differs in its less flattened base, and less conic spire, and the aperture is not diagonal.

In thirteen specimens of the original lot before me, only two are sinistral. In a lot of eight from one of the colonies above Kamalo amphitheatre, six are sinistral; and in a lot of seven from a neighboring colony, two are sinistral. The type is a dextral individual. The color varies ordinarily from marguerite yellow to amber yellow; but a single specimen is a uniform light brownish-corneous; two specimens are yellowish-corneous with a broad brown band just above the periphery and extending on the spire.

In a lot from above the western colony of *Partulina redfieldi kamaloensis,* the parietal callus is thickened, as in *A. cerea.*

22. A. CEREA (Pfeiffer). Pl. 26, figs. 1 to 7.

"Shell slightly perforate, dextral, elongately conic, thin, finely striate, diaphanous, wax colored; spire turrited, apex obtuse; whorls 8, scarcely convex, the last whorl nearly equal

to one-third of the length, slightly compressed at the base; aperture a little oblique, truncately oval; parietal lamella thin; columellar fold obsolete; lip white, with the right margin shortly expanded, dilated at the columella, spreading. Length 8.6, diam. 3.6 mm.; aperture 3 mm. long, 2 wide" (*Pfr.*).

The young of this species is imperforate, with an almost straight not dentate columella. The parietal lamella is very small.

Molokai (Newcomb); near Waikolu (Cooke); Kealia (Borcherding); Upper Kaunakakai (Cooke, Pilsbry); Kawela (Thaanum).

Achatinella cerea PFEIFFER, P. Z. S. Lond., 1855, p. 2, pl. 30, fig. 21.—*Helicteres petitiana* PSE., Journ. de Conchyl., 1868, p. 343.—*Auriculella petitiana* BORCHERDING, l. c., p. 146, pl. 9, figs. 4, 4*a*.—*Auriculella cerea* PFR., Mon. Hel. Viv., viii, p. 210.—ANCEY, Bull. Soc. Mal. France, vi, p. 376.—SYKES, Fauna Hawaiiensis, ii, Moll., p. 376.—BORCHERDING, Zoologica, part 48[2], p. 145, figs. 23, 23*a*, 24, 24*a*.

This species as known to us is usually sinistral, in some colonies entirely so. It is somewhat related to *Auric. brunnea* Smith, from the same island, but has a more attenuate spire and is a decidedly thinner shell. The heavy parietal callus and somewhat larger size distinguish it from *A. newcombi*. As in *Auric. crassula* Sm., there is as far as I know, no white banded form.

No island was mentioned in the original description of *A. cerea*, but Newcomb, who supplied Pfeiffer's type, gave the locality Molokai. No shell exactly agreeing with the original description has been found by modern collectors. The shells we are calling *cerea* are slightly smaller with the whorls fewer by from one and one-half to one-half; but they apparently belong to Pfeiffer's species. The type-figure is copied, pl. 26, fig. 5.

Specimens from Kawela (pl. 26, figs. 4, 6, 7) are mainly naphthalene yellow, but also varying to cinnamon; the yellow form sometimes having a peripheral band of chestnut-brown. In one lot there are 14 sinistral and 5 dextral examples.

Length 7.8, diam. 3.6 mm., with 6½ whorls (fig. 4), or length 7, oblique diam. 3.5 mm., with 6½ whorls (fig. 6). The *parietal callus has a thickened edge,* forming a ridge. In this character the shell differs from *A. newcombi.* It is shorter and relatively broader than Pfeiffer's type of *A. cerea.*

It is abundant on the highlands near Waikolu (pl. 26, figs. 1, 2, 3), on the northern watershed, where the shells are larger and mainly cinnamon-colored, with or without a dark band. When yellow they are more of a chamois tint. Parietal callus is thickened and prominent. Length 8.3, oblique diam. 3.5 mm., with 7½ whorls. All seen are sinistral.

Specimens from Kalihi, Kaunakakai, near the upper end of the pipe-line, vary from chamois through cinnamon (plain or banded) to liver brown; sometimes the last whorl is light, the spire dark vinaceous. Length 7.6, diam. 3.3 mm., with about 7 whorls, or smaller, length 6.4, diam. 3 mm., 6½ whorls. All are sinistral, and the characteristic parietal callus is strongly developed.

23. A. BRUNNEA Smith. Pl. 26, figs. 10 to 15.

"Shell conically ovate, sinistral, subperforate, glossy, chestnut; suture simple, narrowly encircled with white; whorls 7, very slightly convex, the first two polished; apex slightly obtuse; aperture brown; parietal lamina white, thin; lip slightly dilated, united to the columella with a thin whitish callus; columella very slightly reflexed, scarcely plicate. Length 8, diam. 4 mm." (*Sm.*).

Molokai (Smith); Kalamaula (Perkins); Kaluaaha, Moanui (Thaanum); Waiakapuaa (Borcherding).

Auriculella brunnea SMITH, P. Z. S. Lond., 1873, p. 88, pl. 10, fig. 23.—PFEIFFER, Mon. Hel. Viv., viii, p. 212.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 223.—SYKES, Fauna Hawaiiensis, ii, Moll., p. 375.—BORCHERDING, Zoologica, part 48², p. 140, pl. 9, figs. 19, 19*a*, 20, 20*a*.

There are several color varieties of this species, and one color pattern that seems to be peculiar to it, the spire and last whorl above the periphery of a fawn color, while below the periphery the shell is dark chestnut.

The small point, such as Mr. Ancey described as ending on the columella of *A. canalifera,* is sometimes found in this species also. In 1759 specimens examined by Mr. Thaanum and myself only three and one-third per cent were dextral.

The perforate form with a thin parietal callus described as typical is not so common as the imperforate form with a heavy parietal callus. Posteriorly the edge of the callus usually becomes thickened and somewhat tuberculiform. In oblique view in the aperture the columella appears more strongly twisted than that of *A. canalifera.*

24. A. CANALIFERA Ancey. Pl. 19, figs. 1, 2.

"Shell sinistral, imperforate, ovately conic, somewhat thin, glossy, marked with oblique, smooth and obsolete lines of growth, unicolorous tawny, or encircled at the middle of the last whorl with a brown band, or sometimes dark tawny chestnut and encircled by a peripheral whitish band accompanying the suture above. Spire conic, somewhat produced, apex obtuse; whorls 6¼, nearly flat, suture appressed, the last dilated, rotund, short, not ascending. Aperture oblique, irregularly ovate, dilated below, emarginate, armed with a compressed, whitish, small parietal lamina, becoming weaker within. Columella appressed, slightly twisted-plicate, armed with a whitish fold, ending exteriorly in a minute spine; obliquely viewed it appears minutely bisinuate. Lip thin, scarcely thickened except at the columella, with the margins united by a simple and glossy, not tuberculate callus. Length 6.75, diam. 3.6, length of ap. (oblique) 2.5 mm." (*Ancey*).

Molokai: Halawa (Baldwin); Mapulehu Ridge, Kookoholua Thaanum).

Auriculella canalifera ANCEY, Proc. Mal. Soc. London, vi, 1904, p. 121, pl. 7, fig. 11.

"A very characteristic species, remarkable on account of the features of its columella, and unlike any others in that respect. The shell has the texture of *A. diaphana,* but has a more produced spire, different columella and is imperforate" (*Ancey*).

The columellar lip is not built forward, as it is in the imperforate form of *A. brunnea,* which is very closely related.

Species of Lanai.

25. A. LANAIENSIS Cooke, n. sp. Pl. 19, figs. 12 to 16.

The shell is perforate, sinistral, ovately conic, light cinnamon with base slightly lighter, somewhat thin, not diaphanous, hardly glossy, under a lens rather finely striate with lines of growth. Spire nearly conic, apex rather obtuse. Suture lightly impressed, simple. Whorls 6, slightly convex, the last rotund, subsaccate at the base. Aperture broadly oval, slightly diagonal, very slightly oblique. Parietal lamella very slightly developed. Columella simple, scarcely dentate. Lip erect, very slightly thickened, the outer margin curved, the columellar margin reflexed. Umbilicus rather small, subcircular. Length 5.8, diam. 3.0 mm.

Lanai (Thaanum).

Of thirty-four specimens examined, all are sinistral. Some of the largest shells measure nearly 7 mm. in length, while smaller adult specimens are scarcely 5 mm. long. Unfortunately, my specimens were preserved in formalin so that the exact texture cannot be noted. The chief characteristic of this species is the very minute parietal lamella, and a tendency of most of the shells to a light-colored base. This is emphasized, in some of the shells, by a dark band at the periphery. This species is most closely related to *A. flavida*. The latter is usually dextral, and the parietal lamella is more strongly developed; the shell is also more diaphanous.

Probably the specimens reported from Lanai as *A. brunnea* belong to this species.

Species of Maui.

The three Mauian species are very closely related, and their discrimination is sometimes difficult. They are also closely allied to the Molokaian *A. brunnea*. All are quite solid, opaque shells.

a. Shell very broad at the base; umbilicus conspicuously open. *expansa*, no. 28.

a[1]. Shell normal in form; umbilicus moderate or small.

b. Shell very solid, with a *conspicuous tubercle* at upper angle of aperture. *crassula*, no. 27.

b^1. Shell solid, longer, the parietal callus often thick posteriorly, but not so distinctly tuberculiform.
uniplicata, no. 26.

26. A. UNIPLICATA Pease. Pl. 18, figs. 8 to 16.

"Shell solid, perforate, dextral or sinistral, elongately ovate; spire conic, hardly obtuse; suture impressed; whorls 6, flatly convex; longitudinally thinly striated; aperture hardly oblique, truncately oval; lip thickened, with the margins joined by a callus; parietal lamella thin; columella simple, not plicate; yellowish, or brownish, banded with brown. Length 7, diam. 4 mm." (*Pse.*).

West Maui (Baldwin): Iao Valley, Honokohau and Waikee (Thaanum), Maunahooma (Cooke).

Auriculella uniplicata PEASE, Journ. de Conchyl., xvi, 1868, p. 344.—SMITH, P. Z. S. Lond., 1873, p. 88, pl. 10, fig. 21.—PFEIFFER, Mon. Hel. Viv., viii, p. 211.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 222.—SYKES, Fauna Hawaiiensis, ii, Moll., p. 378.—Not of BORCHERDING, Zoologica, part 48^2, p. 138, pl. 9, figs. 14, 14*a*.

Next to *A. auricula* this is the most variable species of the genus. Some large, solid specimens collected by Mr. Thaanum at Honokohau, West Maui, measure 9 mm. in length by 4.6 mm. in breadth. Mr. Sykes has reported this species as coming from Molokai. I feel doubtful as to his identification. Borcherding's specimens are probably a form of *A. brunnea* Smith.

This West Mauian species differs from *A. crassula* by the somewhat more lengthened contour and the less developed thickening at the posterior angle of the aperture. In *uniplicata* the parietal callus forms a ridge, when strongly developed, while in *crassula* it rises in a rounded or oval tubercle.

The form called *A. jucunda* Smith (Ann. Lyc. Nat. Hist. of N. Y., x, 1874, p. 332) was never defined in any way. According to specimens from Gulick's collection (pl. 18, figs. 6, 7, Lahaina, no. 92708 A. N. S. P.) it is a form of *uniplicata* with the parietal callus especially heavy, having some affinity to *A. crassula.*

27. A. CRASSULA Smith. Pl. 18, figs. 1 to 5.

"Shell sinistral (sometimes dextral), ovate-conic, solid, distinctly perforate, hardly glossy, pale brown, whorls 6½, nearly flat; aperture a dirty whitish within; lip thickened, very lightly dilated at the base, prominently furnished with a small tubercle at the juncture of the last whorl; columella thickened, somewhat reflexed, scarcely plicate, joined to the lip by a thin callus; parietal lamina thin. Length 7½, diam. 4 mm." (*Smith*).

East Maui: Makawao (Smith, Baldwin); Olinda (Perkins); Haleakala at 4,000 feet (Perkins); Kailu (Cooke); Keanae (Cooke). West Maui: Iao Valley (Perkins).

Auriculella crassula SM., P. Z. S. Lond., 1873, p. 88, pl. 10, fig. 22.—PFEIFFER, Mon. Hel. Viv., viii, p. 210.—ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 224.—SYKES, Fauna Hawaiiensis, ii, Moll., p. 376. Not of BORCHERDING, Zoologica, p. 143, pl. 9, figs. 20, 20*a*, 22, 22*a*.—*Auriculella ponderosa* ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 225.—*Auriculella solidissima* Smith in BLAND and BINNEY, Ann. Lyc. N. H. of N. Y., x, 1874, p. 331, nude name (Makawao).

This species runs through a number of color varieties, the most common of which is an olive yellow; others have the spire dark, and the suture broadly white-bordered. The white belted pattern, though it occurs in nearly all the species of this genus, and is fairly common in *A. uniplicata*, does not seem to be found in this species; at least no specimen of this color variety was found among over 1,500 specimens seen, but there is sometimes a brown belt at the periphery. The spire is nearly always darker than the last whorl, and there is usually a broad white band just below the suture. Borcherding's specimens from Molokai are probably a broad form of *A. brunnea*, and not the real *crassula*. The prominent tubercle at the posterior end of the thin or thick parietal callus is characteristic.

28. A. EXPANSA Pease. Pl. 19, figs. 3, 4, 5, 6.

"Shell solid, umbilicate, slightly pyramidally ovate, sinistral (rarely dextral), longitudinally thinly striate; flatly com-

pressed at the base; apex obtuse; spire slender, pyramidal, suture impressed; whorls 6, flatly convex, the last large, slightly inflated; strongly extended; lip somewhat reflexed, slightly expanded; parietal lamella strong, white; columella scarcely dilated above; white or pale straw color, sometimes chestnut, with a white band, apex brownish. Length 6, diam. 4 mm." (*Pse.*).

West Maui: Honolua (Thaanum).

Auriculella expansa Pse., Journ. de Conchyl., 1868, xvi, p. 343, pl. 14, fig. 8.—Pfeiffer, Mon. Hel. Viv., viii, p. 210.—Ancey, Bull. Soc. Malac. France, vi, 1889, p. 226; Proc. Malac. Soc. London, vi, p. 121.—*A. expansa* var. *porcellana* Ancey, Bull. Soc. Malac. France, vi, 1889, p. 226.

As pointed out by M. Ancey this species is related to *A. uniplicata*. In fact, some specimens of the latter approach very closely to it. Typical specimens of *A. expansa* are very easily recognized by their diagonal aperture, shorter spire and solid texture. Eight specimens of this species in the Academy of Natural Sciences of Philadelphia (no. 59,047), presented by the author, are very closely related to *A. crassula*. They are rather solid, with a prominent tubercle at the angle of the outer lip. The aperture, however, is more circular and more diagonal than in typical specimens of *A. crassula*, and the base is broader. *A. expansa* seems to be a form related to both *A. uniplicata* and *A. crassula*, but not intermediate between them.

Mr. Ancey's var. *porcellana* is probably a synonym of *A. crassula*. The original account follows: "I have received from the eastern part of the island of Maui a pretty form of *Auriculella* which I refer to *expansa* as a variety (var. *porcellana*), and which differs from the type described above by the absence of any compression of the base of the last whorl, by the smoother shell of a yellowish white, gray towards the summit, by the thin, prominent, compressed parietal lamella, by its relatively small aperture, by its thick peristome, but evidently patulescent at the base and columella only, and by its margins joined by a strong callosity which is thickened towards the superior angle. Shell dextral or sinistral. Length 6, diam. 3½, height of aperture 2½ mm." (*Ancey*).

Species of Hawaii.

29. A. WESTERLUNDIANA Ancey. Pl. 19, figs. 9, 10, 11.

"Shell sinistral, perforate, grayish corneous, fragile, pellucid, ovately conic, glossy, under a lens very finely striate with lines of growth. Spire conic, apex strongly obtuse. Whorls 6, regularly increasing, convex, separated by an impressed suture; the last whorl tumidly rotund, not ascending. Aperture externally and at the base convexly rotund, slightly oblique, emarginate; parietal wall of the aperture furnished with a spirally compressed, elongate and thin lamella; columella edentulous, viewed obliquely it is scarcely twisted-plicate within. Lip thin, simple, lightly and shortly spreading and expanded, reflexed at the columella, covering the dilating perforation; the margins are not united by a callus. Length 6.5, diam. 3.5, length of aperture 2.6 mm." (*Ancey*).

Hawaii: Kona (Baldwin, Perkins, Thwing); Olaa (Perkins, Thaanum); Waimea (Lyons); Hilo (Thaanum); Glenwood (Thaanum, Cooke & Pilsbry).

Auriculella westerlundiana ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 218; op. cit., vii, 1890, p. 721.—SYKES, Proc. Malac. Soc. London, iii, p. 275, pl. 13, fig. 21; Fauna Hawaiiensis, ii, Moll., p. 379.

M. Ancey in a note (Bull. Soc. Malac. France, vii, 1890, p. 721) mentions three color varieties of this species: corneous with a broad brown band; unicolorous, pale yellow; subcorneous, pellucid; chestnut without bands.

This species is very distinct. Some of the thinner varieties of *A. uniplicata* somewhat resemble it, but the thickened lip, more solid shell, and less rotund aperture of the former easily distinguish the two species. It has some resemblance to *A. perpusilla* of Oahu, but a comparison of the diagnoses will easily separate the two. *A. westerlundiana* is consistently sinistral.

Genus GULICKIA Cooke, n. gen.

The shells are *sinistral,* minutely perforate in the adult stage. *Embryonic whorls spirally striate.* Parietal lamella oblique. Columella slightly *sigmoid,* furnished with two *almost equal,* rather strong, oblique folds. Peristome thin, unexpanded. Animal oviparous. Type, *G. alexandri.*

This genus is intermediate between *Auriculella, Tornatellides* and *Tornatellaria.* It is probably most closely related to *Auriculella,* from which it differs by the striate embryonic whorl, fragile outer lip and the subequal columellar lamellæ.

In form, size and the strong oblique parietal lamella it approaches some of the species of *Tornatellides.* It is related to *Tornatellaria* by its spirally striate embryonic whorls and oviparous reproduction. The position and form of the columellar folds and also the closed umbilicus of immature specimens places *Gulickia* very close to *Auriculella,* but in *Auriculella* mature shells have a slightly or much thickened peristome. In *Gulickia,* the peristome is thin, as in *Tornatellina.* This and some of the Auriculellæ are the only sinistral Hawaiian species of *Tornatellinidæ.* In immature specimens the oblique upper columellar fold extends to form the margin of the columella. The genus is dedicated to John T. Gulick.

1. G. ALEXANDRI Cooke, n. sp. Pl. 28, fig. 7.

Shell sinistral, minutely perforate, acutely conical, turrited, corneous, thin, subdiaphanous, shining, nearly smooth, minutely striate with lines of growth. Spire conic, apex somewhat obtuse, embryonic whorls minutely spirally striate. Suture simple, slightly impressed. Whorls 6¾, slightly convex, slowly increasing, compressed, the upper convex, the last somewhat rotund, slightly angular at its beginning, convex at the base. Aperture somewhat oblique, ovate. Parietal lamella quite strong, very oblique, arcuate, *minutely and irregularly serrate.* Columella nearly straight, slightly sigmoid (in immature specimens), narrowly triangular, with two well-developed oblique lamellæ. Peristome simple, thin, unexpanded, the outer margin arcuate. Length 3.5, diam. 1.7, axis of apert. 1.3 mm. Parietal lamella 0.22 mm. in height.

W. Maui: Maunahooma (Cooke, Forbes); Honokowai (Thaanum). Type no. 14148 (Bishop Mus.); cotypes no. 13871 (Bishop Museum), and no. 111919 A. N. S. P.

In adult shells the columellar folds are less oblique than in immature specimens, and extend nearly to the margin of the columella.

In the original series collected by the author about 40 specimens were taken. A later trip by Mr. Forbes and the author yielded only 12 specimens. All the specimens were taken on the trunks of guava trees.

Genus ELASMIAS Pilsbry.

Elasmias Pils., Nautilus xxiii, March, 1910, p. 122, type *Tornatellina aperta* Pse.

The shell is imperforate, globose-conic or rotund-ovate, composed of few (3 to 4½) whorls, usually striate spirally. Aperture large, the columella calloused, in form of a wide or narrow vertical plate, bilobed or angular, but without deeply entering lamellæ, truncate or excavated below the plate; parietal lamella as usual in the family. Viviparous or ovo-viviparous. Radula as in *Tornatellina*.

Type: *E. apertum* (Pse.). Distribution: islands of the central and western Pacific and Indian Ocean; Australia. Living on the leaves of plants.

This genus occurs in some places throughout the range of the family with the exception of New Zealand and the islands off South America. In the area both inhabit, *Elasmias* is far less generally diffused than *Tornatellina*.

"The animal [of *E. apertum*], which is very active, is subpellucid with dusky tentacles. The foot is oblong, rounded behind, and nearly as long as the shell. The eye-peduncles are stout. Labial tentacles, none. Muzzle large, dilated, and aids in locomotion" (*Garrett*).

Professor C. Semper dissected *T. manilensis*, but did not obtain a successful preparation of the genitalia. He noted that "the penis appeared to be simple. In the uterus were four or five eggs, the lowest containing a fully-developed embryo, the shell of which formed more than one entire whorl.

The kidney was band-like, very narrow. The radula was not isolated entire. The teeth seem to be all alike, but whether the central tooth was lacking was not determined. The teeth have a very long, fine and curved middle cusp and a little cusp on each side." It is obvious that Semper's "middle cusp" is really the basal-plate. Probably the fragment was seen from below, being mounted upside down. The radula of *E. aperta,* examined by W. G. Binney, has "an exceedingly large number of teeth" arranged obliquely in waving rows, the teeth of the same type as those of *Achatinella* (pl. 31, fig. 10).

Significance of the characteristics of Elasmias.—The chief characters of *Elasmias* are those of early stages of *Tornatellina* and *Auriculella.* The small number of whorls, globose contour, broadened columella, large lamellæ and spiral striation are traits of the end of the embryonic and beginning of the neanic stages in the other genera. So far as we may estimate the affinities of the genus, it is an arrested type, probably not far removed from the ancestral Tornatellinid stock. When the complete anatomy is compared, this view can be tested. Meantime, the very wide distribution of the species, in an area the least favorable for migration, argues for the great antiquity of the genus. As in many other genera and families actually known to be very old, the species are much alike and not numerous, probably due to the general extinction of phyletic side lines. *Lamellovum* seems to be a specialized collateral group of the *Elasmias* stock which has survived in a single isolated locality.

At first the uterine shell has a slender, somewhat sinuous but not folded columella, and there is no parietal lamella (pl. 31, fig. 2, a shell of 0.6 mm. diameter). Immediately after this stage the parietal lamella arises (pl. 29, fig. 9), and the columella broadens (pl. 29, fig. 8). By the end of the embryonic stage (pl. 31, fig. 3, diam. 0.8 mm.) the parietal and columellar lamellæ are strongly developed. In some species they diminish in relative size in the later neanic stage, in others, such as *fuscum* and *cernicum,* the lamellæ continue strong.

Distribution of Elasmias.

Hawaiian Islands: 1, *E. fuscum.* 2, *E. luakahaense.* 3, *E. anceyanum.*

Polynesia: 4, *E. ovatum.* 4*a*, *E. o. apertum.* 5, *E. peaseanum.*

Australia, New Guinea: 6, *E. wakefieldiæ* (*T. eucharis, T. terrestris*).

New Caledonia: 7, *E. mariei.*

Philippines, East Indies, Maldive Is.: 8, *E. manilense.* 9, *E. citreum.* 10. *E. sundanum.*

Mauritius, Bourbon: 11, *E. cernicum.*

Caroline Is.: 12, *E. ovatulum.*

Marianne Is.: 13, *E. quadrasi.*

Islands of Izu, Japan: 14, *E. kitaiwojimanum.*

Hawaiian Species.

a. Parietal lamella strongly developed in adults; columellar plate broad.

b. Shell not transparent, brownish. *E. fuscum,* no. 1.

bb. Shell thin, transparent, corneous. *E. luakahaense,* no. 2.

aa. Parietal lamella low; columellar plate narrow. *E. anceyanum,* no. 3.

1. E. FUSCUM (Ancey). Pl. 29, figs. 1 to 6.

Shell broadly ovate-conoidal, imperforate, moderately thin but somewhat solid, tawny corneous, faintly marked with growth-striæ. Spire conic, obtuse, short, less than one-half the length of the shell. Whorls 4½, convex, suture not deep, the last large, ovate. Aperture ample, irregularly ovate, tapering above, distinctly oblique. Parietal lamella white, large, compressed, quite prominent but short, soon disappearing. Columellar process callous and flat, equal in size to that of *T. aperta,* with the callus slightly twisted above, obliquely truncate below. Length 3.25, diam. 2.2, length of aperture 1.75 mm. (*Ancey*).

Hawaii: Olaa, Puna (type loc., Thaanum), Kona (Henshaw), Crest of Kilauea (B. Sharp). Maui: Kaupakalua

(Baldwin). Molokai: Puunea and Kamalo (Thaanum, Cooke, Pilsbry). Oahu: western ridge of Popouwela (Spalding, Pilsbry and Cooke).

Tornatellina fusca ANCEY, Journ. de Conchyl., li, 1903, pp. 306, 307, pl. 12, figs. 23, 24.—HENSHAW, Journ. of Malac., xi, 1904, p. 64.

"The species of Hawaiian *Tornatellina* which is most closely related to *fusca* is, without doubt, *aperta*; but the former is more robust, more solid, darker colored, and the spire is more nearly conic. It is also larger, and the lamellæ though somewhat alike are different. In some of the young examples, there are besides, two parallel dentiform plicæ in the interior of the right margin (a remarkable character and one not existing in *aperta*). The parietal lamella is white, prominent, compressed, but does not extend far into the interior. The columella has a strongly-developed callus dilation, which is flat, sinuous, and analogous to that of *aperta*, twisted at its insertion, denticulate and broadly truncate at the end" (*Ancey*).

Ancey's type specimen (no. 18434, B. P. Bishop Museum) is badly broken, as can be seen in his illustration, and it is not quite adult.

The largest specimen (fig. 1) observed is from Kona, Hawaii, and was collected by Mr. Henshaw. It measures: length 3.95, diam. 2.25, length of aperture 1.8 mm., and has 4¾ whorls. The parietal lamella is very strong (0.43 mm. in height), and flares outward. The columella bears a large flat oblong callus (length 0.61, width 0.43 mm.) on its margin. This columellar plate is thickened along its margin and this thickening extends, as a rather prominent ridge, just above the base, and nearly to the outer margin of the columella.

In young specimens at the metaconic substage, with about 4 whorls, the parietal fold is thickened, forming two or three ridges parallel to its margin. The columellar plate is triangular in outline, with its inner margin sinuous and indistinctly biplicate. There are two more or less distinct palatal folds—one basal the other just below the periphery. Figs. 5, 6.

At younger stages the palatal folds are more prominent

and the inner margin of the columellar plate is more distinctly biplicate.

The interior of a Popouwela (Oahu) specimen is drawn in pl. 28, fig. 6. The largest seen from this locality is 3.2 mm. long.

There is a decidedly paler form, which may be called *E. f. obtusum* (pl. 28, fig. 5), with less swollen whorls and more obtuse summit on the western ridge of Popouwela, where it occurs with the dark typical form. The figured specimen measures, length 2.7, diam. 1.8 mm.

2. E. LUAKAHAENSE n. sp. Pl. 29, figs. 7, 8, 9, 10,

Shell globosely-ovate, light corneous, thin, semi-transparent, somewhat shining, nearly smooth, under a lens minutely marked with growth-striæ. Spire convex in outlines, summit obtuse. Suture simple, well impressed. Whorls almost 4, convex, increasing rather rapidly; the last broadly ovate, with a convex base. Aperture large, irregularly ovate, oblique. Parietal lamella strong, flaring outwards, thin, arcuate in section. Columella vertical, slightly twisted. Columellar plate large, broad, irregularly triangular, concave below, with its inner margin sinuous, slightly twisted, thickened—the thickening extending as a ridge just above the concave base of the plate, and reaching nearly to the outer margin of the columella. Outer lip thin, convex. Length 2.5, diam. 1.6, length of aperture 1.4 mm.

Kauai: Halemanu, Wailua (Cooke). Oahu: Nuuanu, Luakaha (type loc.); Manoa, Punaluu, and Kaliuwaa (Cooke); Waialua (Lyman). Type no. 14145, B. P. Bishop Museum.

Tornatellina aperta ANCEY, Journ. de Conchyl., li, 1903, p. 295, not of Pease.

Ancey's specimens are in the collection of the Bishop Museum, no. 18467.

E. luakahaense is a much smaller species than *E. apertum*, and in adult specimens there are two less whorls. The shell is more fragile and lighter colored and the parietal lamella and columellar plate are much more strongly developed in proportion to the size of the aperture than in Pease's species.

In the latter the columellar plate is oblong and distinctly bidentate. The shells of *E. luakahaense* are much smaller, lighter colored and thinner than those of *E. fuscum*. In adult specimens the columellar plate is not as strongly developed as in *fuscum*. In fresh specimens of *E. luakahaense* the shells are covered with a whitish deposit. This character appears to be lacking in *E. fuscum* and *E. anceyanum*. All the specimens from Kaliuwaa are whitish-vitreous with a brown summit.

In embryonic specimens (figs. 7, 8) the shell is globose; the spire is shorter than in embryos of *Tornatellina*; the surface is minutely marked with growth-striæ and is without raised spiral striæ; the parietal lamella is straight in section, about a half a whorl in length; the columella is vertical; the columellar plate is oblong, narrow, with an almost straight inner margin.

A young specimen (fig. 10), at metaneanic stage, is 1.35 mm. in length and has slightly over 3 whorls. The parietal lamella is very strongly developed, flaring outward and arcuate in section; the columellar plate is stronger than that of an adult; there is a single short low basal palatal fold.

In *E. luakahaense* the presence of palatal folds are not as constant a character as in *E. fuscum*. In the young of some colonies these folds are entirely absent, in others there may be from one to three folds, while in a few colonies all the young have three distinct folds—one basal, a second just below and a third just above the free edge of the parietal lamella. Only about a third of the young from the type locality have one or more palatal folds developed.

3. E. ANCEYANUM n. sp. Pl. 31, figs. 7, 8.

Shell broad, ovately-conic, brownish corneous, thin, transparent, glossy, nearly smooth, under a strong lens minutely marked with growth-striæ. Spire somewhat conic, with slightly convex outlines, summit obtuse. Suture simple, impressed. Whorls 4½, convex, increasing rather rapidly, the last subovate, rounded, with a convex base. Aperture large, subovate, oblique. Parietal lamella small, erect. Columella

slightly twisted; columellar plate almost vertical, narrowly rectilinear, with its inner margin nearly straight. Outer lip thin, convex. Length 3.1, diam. 1.7, length of aperture 1.4 mm.

West Maui: Maunahooma (Cooke). Type no 14147, B. P. Bishop Museum coll.

From *E. fuscum* this species differs in the thinness of its shell and in its much smaller parietal lamella and columellar plate. From *luakahaense* it differs in size, form of the shell, and its much smaller parietal lamella and columellar plate.

A young specimen (at the metaneanic stage), from the type lot, is 1.7 mm. in length and has 3½ whorls. The parietal lamella is very strong, flaring outward. The columellar plate is strong, triangular in outline, its margin is twisted, thickened, with the thickening continued along the base, and forming a rather prominent tooth at the inner basal angle of the columellar plate. With further development the apertural armature becomes less prominent, being noticeably decadent in the adult stage. No palatal laminæ have been observed in a large series of the young of this species.

Polynesian species.

4. E. OVATUM (Anton). Pl. 30, fig. 1.

Oval ventricose; 3 ventricose whorls, with deep suture, last whorl two-thirds the whole; apex obtuse; aperture oval, with two lamellæ on the columella, the lower broadly curved around. Breadth 1, height 1½ lines (*Anton*).

The small shell is ovate, rather ventricose, glossy, very finely striate with growth-lines, nearly transparent, corneous-yellow; the spire short, somewhat turrited, obtuse; the 3½ whorls are moderately high, convex, united by a simple, somewhat impressed, suture, which is the more distinct because of the nearly flat upper surface [of the whorls]; last whorl is ventricose, scarcely two-thirds the total length, rounded below. The aperture is narrowly half-ovate; on the parietal wall there is a short, very thin, broadly projecting, somewhat oblique white plate; on the columella an equally strongly-pro-

jecting, sharply mucronate [*geschweifte*] fold; the peristome unexpanded, acute (*Kuester*).

Length 3½, diam. 2⅓ mm. (*Pfr.*).

Opana [= Opara or Rapa, Austral Group] (Anton).

Strobilus ovatus Anton, Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinden, p. 46, no. 1697 (1839).—*Achatina ovata* Ant., Pfr., Symbolæ, i, p. 29.—*Tornatellina ovata* Anton, Pfeiffer, Monographia, ii, p. 394; iii, p. 526; iv, p. 652; vi, p. 264.—Kuester, Conchylien Cabinet, *Pupa*, p. 150, pl. 18, figs. 12, 13.

Kuester's figure is copied. It may have been drawn from the type, though that is not stated. It is probably not separable specifically from *E. apertum* Pease. This type of shell is widely distributed in Polynesia, and not enough material is available for a definite opinion as to the status of the forms from different islands. As we have seen no specimens from Rapa, it seems wise to attempt no decision as to whether the *ovatum* group may best be classed as one species or as a group of closely-related species or subspecies. When series of all ages and from various islands have been obtained by leaf-sifting, the question may be approached with less danger of undue lumping or of premature splitting.

4*a*. E. ovatum apertum (Pease). Pl. 30, figs. 2, 3.

Shell globose-ovate, imperforate, thin, pellucid, glossy, brown-corneous; spire obtuse; suture impressed; whorls 4, rotund-convex, the last subglobose, about equal to two-thirds of the length; aperture ovate, subauriform, large, about equal to half the length of the shell; lip thin, acute; columella compressed, bidentate, obliquely truncate; parietal lamella scarcely prominent; base rotund. Length 3½, diam. 2½ mm. (*Pease*).

Society Islands: Tahiti (Pease); Huaheine; ranges throughout the group, not uncommon on foliage (Garrett); Marquesas Is. (Garrett). Rotuma (Gardiner). Tongatabu (Leefe). Sunday Island, Kermadec Is. (Tom Iredale).

Tornatellina aperta Pease, Proc. Zool. Soc. Lond., 1864, p. 673; 1871, p. 473.—Pfeiffer, Monographia, vi, p. 264.—Gar-

RETT, Journ. A. N. S. Phila., ix, p. 83, pl. 2, fig. 20.—SCHMELTZ, Mus. Godeffroy, Cat. v, p. 90.—SMITH, Ann. and Mag. N. H., 1897, xx, p. 521.—BINNEY, Ann. N. Y. Acad. Sci., iii, p. 99, pl. 3, f. F (teeth).

Except in the pale brown color, darkening slightly towards the summit, this form does not seem to differ materially from *E. ovatum* of Rapa; but the only published figure of the latter is not sufficiently exact for a critical comparison. Probably *E. apertum* may be a form or subspecies of *ovatum*. *E. fuscum* is a decidedly darker color than *apertum*, and has stronger lamellæ. *E. cernicum* also has larger lamellæ. Under the microscope the surface of *E. apertum* shows only very faint and fragmentary spiral lines in some places.

A typical specimen has been figured by Garrett, and is redrawn in pl. 30, fig. 2. The parietal lamella is rather strong, and little over a fourth of a whorl long. Length 2.7, diam. 2.5 mm. In others of the same lot, somewhat smaller, the parietal lamella is lower.

Specimens from Huaheine (pl. 30, fig. 3) have the parietal lamella lower than in typical *apertum*, and the spiral striation more distinct. Length 2.4 mm.

A series from Sunday Island, Kermadec group (pl. 30, figs. 4, 5), the parietal lamella is very low in adults, a little more prominent in the young. Spiral striation barely discernible in places. The largest measures, length 4.5, oblique diam. 2.6 mm., with 4⅓ whorls. An infant with 2¼ whorls (pl. 30, fig. 5, length 1⅓ mm.) shows relatively stronger lamellæ than the adult. There are no palatal plicæ at any age. The color is corneous, shading into cream-buff towards the summit.

Mr. Edgar A. Smith remarks that "the type from Tahiti is a little larger and somewhat browner than the shells from Rotuma, but is similar in other respects." From this it appears that the Rotuma specimens resemble those of the Kermadecs in color, both being of the tint attributed to *E. ovatum*, while Society Island shells have a perceptible tint of russet.

5. E. PEASEANUM (Garrett). Pl. 31, fig. 5.

"Shell imperforate, oblong-ovate, smooth, thin, shining, faintly striated, dark brownish horn-color; spire conical, with nearly planulate outlines and subacute apex; suture faintly impressed; whorls five and a half, convex, moderately increasing, last one large, rounded, not descending in front; aperture large, oblique, truncately ovate, nearly half the length of the shell; peristome thin, straight, regularly curved; parietal region with a prominent, thin, revolving white lamina, which is slightly reflected posteriorly; columella armed with a prominent, nearly vertical, bidentate plait. Length 5, diam. 2½ mm." (*Garrett*).

Society Is.: Moorea Island, very rare on foliage (Garrett).

Tornatellina peasana GARRETT, Journal of the Acad. Nat. Sciences of Phila., 2d ser., ix, p. 83, pl. 2, f. 19, 1883.

"Closely allied to *aperta,* but much larger more elongate, darker color and the spire more produced." The tapering summit and subacute apex are further distinctions from *apertum,* which has a far more obtuse apex. Garrett's figured type, is redrawn in our plate. The number of whorls is wrongly given by Garrett. There are 4½ in the type-specimen, which measures, length 4.9, oblique diam. 2.7 mm.

Species of Australia, New Guinea and New Caledonia.

Critical comparisons will probably reduce the number of species recorded from this area.

6. E. WAKEFIELDIÆ (Cox). Pl. 30, figs. 9, 10.

"Shell imperforate, ovately-conical, very thin, translucent, rather shining, smooth, microscopically striated, yellowish-horny; spire conical, obtuse at the apex; whorls 4, slightly convex, last large, tumid, equaling one-half of the length; aperture irregularly ovate, with a very thin central, vertical, parietal plate; columella thinly expanded and revolute inwards, grooved above; peristome simple, acute.

Length 0.10, breadth 0.07, aperture 0.05 long, of an inch" (*Cox*).

Australia: Grafton, Clarence River, in decaying wood

(Wakefield, type loc.); near Lismore and on the Clarence River (Petterd); vicinity of Brisbane, Queensland, on orange trees (H. Tryon). Bryon Bay, N. S. Wales (Australian Mus.). Ballina, Richmond River, on flowers and leaves of *Hibiscus* (Ramsey).

Achatinella wakefieldiæ Cox, Monograph of Australian Land Shells, p. 78 (1868).—*Tornatellina wakefieldiæ* Petterd, Journ. de Conchyl., xxv, 1877, p. 361.—Pfeiffer, Monographia, viii, p. 318.—*Tornatellina wakefieldæ* Cox, Hedley, Records of the Australian Museum, iii, 1899, p. 153, pl. 28, fig. 14.

The shell is globosely-ovate, corneous, and under a lens, very finely but not very distinctly striate spirally. The parietal lamella is very low. Columellar plate is quite short and distinctly bilobed. Length 2.5, diam. 2.1 mm.; 3½ whorls (fig. 10). Mr. Hedley's figure of *E. wakefieldiæ* from Bryon Bay, N. S. W., is copied in fig. 9. Fig. 10 is from a younger New South Wales example.

The distinctions between this species, *T. eucharis* and *T. terrestris* have not been pointed out, if any exist. According to Hedley's figures, *eucharis* has a shorter spire and larger aperture, but these differences may be due to the different ages of the examples figured. We have not seen either of Brazier's species, and until they are furnished with differential characters it hardly seems worth while to admit them as species. All published information is repeated below.

Tornatellina eucharis Brazier. Pl. 30, fig. 8. "Shell imperforated, somewhat ovately conical, thin, transparent, glossy, very finely striated and decussated with finer striæ; pale-straw color. Whorls 3½, convex, the last large and inflated, three-fourths the whole length, spire very short, apex roundly obtuse; thickened long callus tooth on the centre of body-whorl entering spirally; base rounded. Aperture nearly vertical, ovate, peristome membranous, margins regular, the outer arched, columella twisted, rather thickened, entering spirally inwards, leaving about it a small groove. Length 1¼, breadth 1 line" (*Brazier*).

Barnard Islands No. 3, North-East Australia (Chevert Exped.).

"This graceful species is closely allied to *Tornatellina terrestris* Braz. Two specimens found on bushes at the above islands" (*Brazier*).

Tornatellina eucharis Brazier, Proc. Linn. Soc. N. S. Wales, i, 1876, p. 110.—Hedley, P. L. S. N. S. W., xxvi, 1901, p. 705, pl. 34, fig. 12.—*T. lucharis,* Zoological Record, vol. 39, 1902, Moll., p. 67.

"One of the two type specimens from No. III, Barnard Islands, 2.5 mm. long, is here shown. I am doubtful if it be not the young of *T. wakefieldæ* Cox. *T. eucharis* occurred to me on Fitzroy Island, Queensland. *T. aperta* Pease seems closely allied" (*Hedley*). Fig. 8 is copied from Hedley.

Tornatellina terrestris Brazier. "Shell imperforated, ovately-conical, thin, translucent, rather smooth, obsoletely striated and spirally lined with silky striæ; pale, horny. Whorls 3½, roundly convex, the last large, and globosely inflated, suture impressed, spire short, obtuse at the apex, aperture very slightly oblique, rounded-ovate; small, nearly obsolete thin long tooth on the centre of the body-whorl; peristome thin, acute, margins regular, the columella rather thickened, straight, with a thin long broad plate, sub-twisted and bent in the centre, entering spirally inwards, as seen from the inside, fine decussating lines all through. Length 1½, breadth 1 line" (*Brazier*).

Yule Island, New Guinea; found on the ground under leaves (Chevert Exped.).

Tornatellina terrestris Brazier, Proc. Linn. Soc. N. S. Wales, i, 1876, p. 109.

No distinctions of specific value between this, *E. eucharis* and *E. wakefieldiæ* appear in the description. Until such are pointed out, it hardly deserves a place among recognized species.

7. E. mariei (Crosse). Pl. 30, figs. 11, 12.

Shell imperforate, shortly conic, ovate-ventricose, thin, pellucid, corneous-hyaline. Spire short, the apex rather obtuse; suture little impressed. Whorls 4, a little convex, the last inflated, longer than the spire, rounded basally. Aperture ro-

tund-lunar, colored like the outside, provided with an inconspicuous entering parietal lamella. Peristome simple, the columellar margin provided with a strong whitish fold, basal and outer margins acute. Length 2½, diam. 2 mm. (*Crosse*).

New Caledonia: Baie du Sud (E. Marie).

Tornatellina mariei Crosse, Journ. de Conchyl., xxii, 1874, pp. 109, 393, pl. 12, f. 7; xlii, 1894, p. 306.—Gassies, Faune Conch. N. Caled., iii, in Actes Soc. Linn. Bord., 1880, p. 48, pl. 2, f. 22.—Pfr., Monogr., viii, p. 319.

"This species is shorter and especially more swollen than *T. noumeensis*; it is also thinner and has a better developed columellar fold" (*Crosse*).

Crosse's figure, copied in our fig. 11, is not very good. A specimen received from E. Marie is drawn in fig. 12, length 2.4 mm. It is closely related to *E. wakefieldiæ* (Cox), but probably distinct by its more elevated spire. Extremely fine spiral striation may be seen on the last whorl.

Species of the Philippines, East Indies and Islands of the Indian Ocean.

8. E. manilense (Dohrn).

Shell ovate-conic, thin, smooth, pellucid, corneous. Spire conic, rather obtuse. Whorls 5, convex, the last scarcely two-thirds the length of the spire. Aperture oblong-semioval. Parietal lamella median, compressed, the crest curved laterally. Columella oblique, white-callused, slightly truncate. Peristome acute, unexpanded. Length 4.5, diam. 3, length of aperture 2 mm. (*Dohrn*).

Philippine Is.: Manila, Luzon, Ubay, Bohol (Dr. C. Semper). Maldive Group: Hulule, North Male Atoll (Gardiner). Natuna Is.: Bunguran (A. Everett).

Tornatellina manilense Dohrn, Malakozoologischer Blätter, x, 1863, p. 160.—Pfeiffer, Monographia, vi, p. 364.—Semper, Reisen im Archip. Philippinen, Landmoll., pp. 133, 140, pl. 16, f. 13 (teeth).—E. A. Smith, in Gardiner's Fauna and Geography of the Maldive and Laccadive Archipelagoes, i, pt. 2, 1902, p. 144.

From the two most nearly related species, *ovata* and *cornica*,

easy to tell by the smaller aperture, the simple columella, and the last whorl not inflated. From *cernica* also by the surface of the shell not decussate (*Dohrn*).

According to Semper, this species lives among and on the leaves of water plants, and not infrequently crawls rather high on the trunks of mangroves. Possibly this observation was based on some small and superficially similar *Assiminea*, as *Tornatellinidæ* usually are no more aquatic in station than *Pupillidæ*.

The specimens seen from Manila (pl. 31, fig. 6, length 2.7 mm.) do not agree well with Dohrn's description, and their identity with his type must be regarded as doubtful. There are slightly over four convex whorls, the first minutely striate spirally, the rest only faintly marked with growth-lines. Parietal lamella rather small and about one-third of a whorl long. Columella convex, narrow, not much callused, and indistinctly bilobed. *Cf. T. kochiana.*

The Maldive and Natuna records are from E. A. Smith, who states that he cannot distinguish the Maldive specimens from the Philippine form, and that the shells described as *T. natunensis* are the same. The original description of the latter is translated below, and the figure is copied.

"*Tornatellina natunensis.* Pl. 38, fig. 16. Shell small, ovate, subconoid above, thin, subpellucid, pale brownish, imperforate; striated with delicate lines of growth. Whorls 4, convex, the apex large, rounded. Aperture perpendicular, inversely auriform, a little less than half of the total length. Peristome thin, the columellar margin slightly twisted, hardly thickened or reflexed. Parietal lamella very thin, entering. Length 2.5 mm., diam. 1.5, aperture 1.3 long, .75 wide" (*E. A. Smith*). Natuna Islands: Bunguran (A. Everett).

Tornatellina natunensis E. A. Smith, Annals and Magazine of Nat. Hist. (6), xiii, June, 1894, p. 458, pl. 16, f. 7.

8. E. citreum (Smith). Pl. 30, figs. 6, 7.

Shell minute, imperforate, ovate, thin, brownish-corneous, little shining, striated with delicate oblique growth-lines. Spire short, very obtuse. Whorls 3½, very convex, the last

subglobose. Aperture auriform, a little exceeding half the total length, furnished with a single minute parietal tooth. Outer lip thin, arcuate. Columella straight, thick, at the base abruptly truncate. Length 2, diam. 1.5 mm. (*Smith*).

Lombock Island, on orange trees (A. Everett).

Tornatellina citrea E. A. Smith, Proc. Malac. Soc. London, iii, April, 1898, p. 30, pl. 2, f. 17.

"Under the microscope the surface has a minutely frosted appearance, produced by excessively fine spiral striation" (*Smith*).

The apertural lamellæ are very much reduced in this species. The adult form, shown in Mr. Smith's figure, which is copied on pl. 30, fig. 7, has only an extremely narrow, straight columella, truncate at the base, but half-grown shells of 2½ whorls (pl. 30, fig. 6, length 1.5 mm.) have a broader columellar plate with convex edge. The shell, at all stages of growth, is decidedly fragile. Though smaller, it has some resemblance to *E. anceyana.*

10. E. sundanum (Moellendorff).

Shell imperforate, ovate-conic, thin, subpellucid, very lightly striatulate, opaque, buff-corneous. Spire moderately elevated for the genus, convexly conoid. Whorls 4, a little convex, rather rapidly increasing, the last quite convex. Aperture not very oblique, oval, somewhat excised. Peristome unexpanded, acute. Columella lamellarly dilated above, truncate in the middle. Parietal lamella moderate, produced deep within. Length 3, diam. 2 mm. (*Mlldff.*).

Java (H. Fruhstorfer).

Tornatellina sundana Mlldff., Nachrbl. d. D. Malak. Ges., vol. 29, August, 1897, p. 90.

11. E. cernicum (Benson). Pl. 31, figs. 1, 2, 3, 4.

Shell globosely conic, thin, striatulate, obsoletely decussated by extremely fine spiral striæ, pale corneous, pellucid, glossy. Spire conic, the apex obtuse, ruddy. Whorls 4, convex. Aperture elliptical-ovate, longer than the spire, contracted by two folds: one lamelliform, entering, hyaline pari-

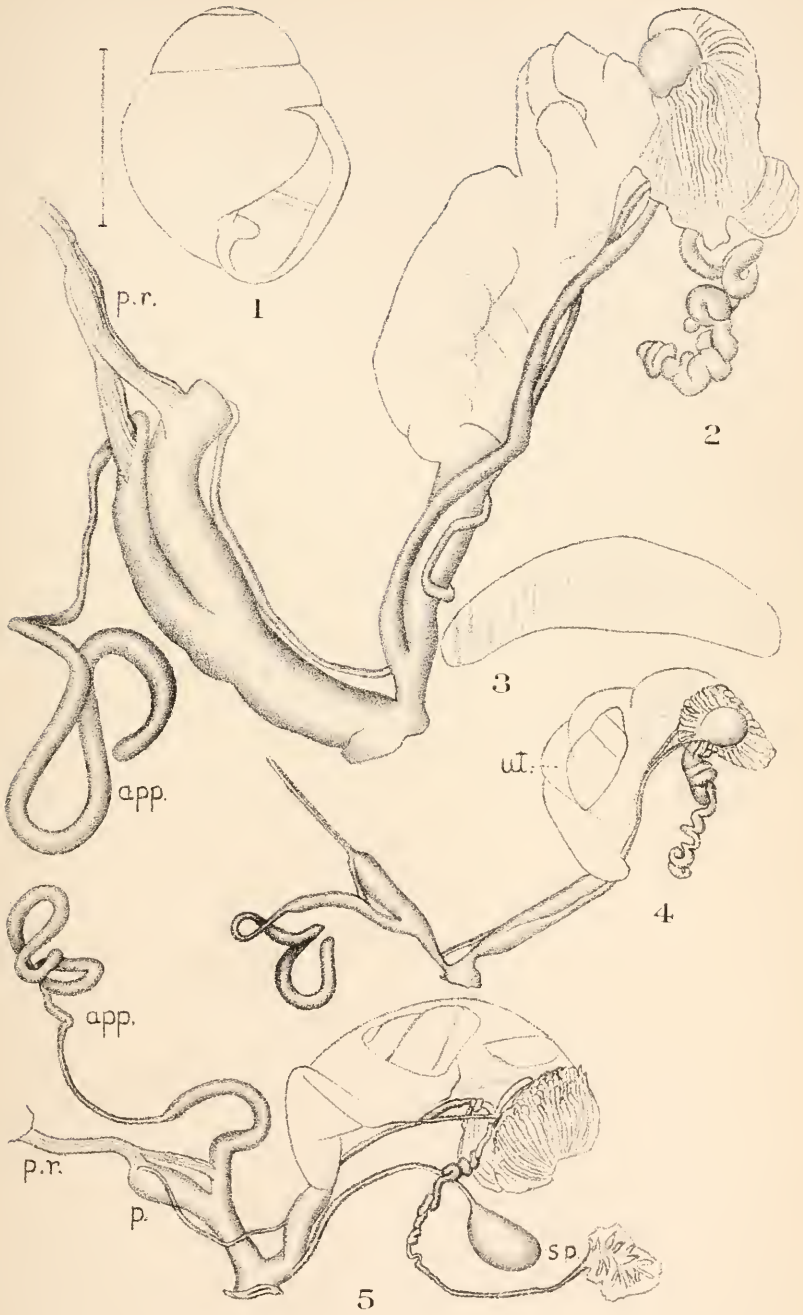
etal fold, and two dentiform columellar folds, placed at the angle of the truncate columella. Columella broad, vertical, hyaline, obliquely and broadly truncate. Right margin simple, acute. Length 3, diam. 2 to 2¼ mm. (*Benson*).

Mauritius: Moka, on the grounds of Sir D. Barclay, creeping in showery weather on the leaves of Niecioli hedges (Benson); Reduit ravine and Vacoa (Möbius). Bourbon: above Salazie (G. Nevill).

Tornatellina cernica Bens., Annals and Magazine of Natural History (2), vi, October, 1850, p. 254.—Pfeiffer, Monographia, iii, p. 526.—Kuester, Conchylien Cabinet, *Pupa*, p. 155, pl. 18, figs. 30, 31.—von Martens, in Möbius, Beiträge zur Meeresfauna der Insel Mauritius u. der Seychellen, 1880, p. 199.—*Tornatellina* (*Septinaria*) *cernica* Bens., G. Nevill, Journal of the Asiatic Society of Bengal, xxxix, 1870, pt. 2, p. 413.—*Tornatellina mauritiana* Pfeiffer, Proc. Zool. Soc. Lond., 1852, p. 150.—*Achatina minutissima* Barclay Ms., according to Pfeiffer.

This species has a broad columellar plate, which is thin above the lower lamella until the fully adult stage, when the upper fold becomes distinct. The parietal lamella is about the third of a whorl long. No examples with palatal plicæ have been seen, but the mid-neanic stage is not represented in the series examined. One specimen opened contained two embryo shells, one, of nearly two whorls, diameter 0.8 mm., was probably about to be born, and represents the end of the embryonic stage (fig. 3). It has a large parietal lamella about half a whorl long, and a wide columellar plate differing very little from the adult stage. A smaller embryo, above the preceding in the parent shell, has about 1½ whorls, with a diameter of 0.6 mm. (pl. 31, fig. 2). There is no parietal lamella, and the slightly sinuous columella is thin and simple. It appears that the apertural lamellæ are very rapidly developed in the last part of the embryonic stage.

It remains to call attention to the remarkable similarity of the Hawaiian *E. fuscum* to this species, almost the only differences being that *fuscum* has larger lamellæ and is darker in color. The lamellæ of *E. cernicum* are more strongly devel-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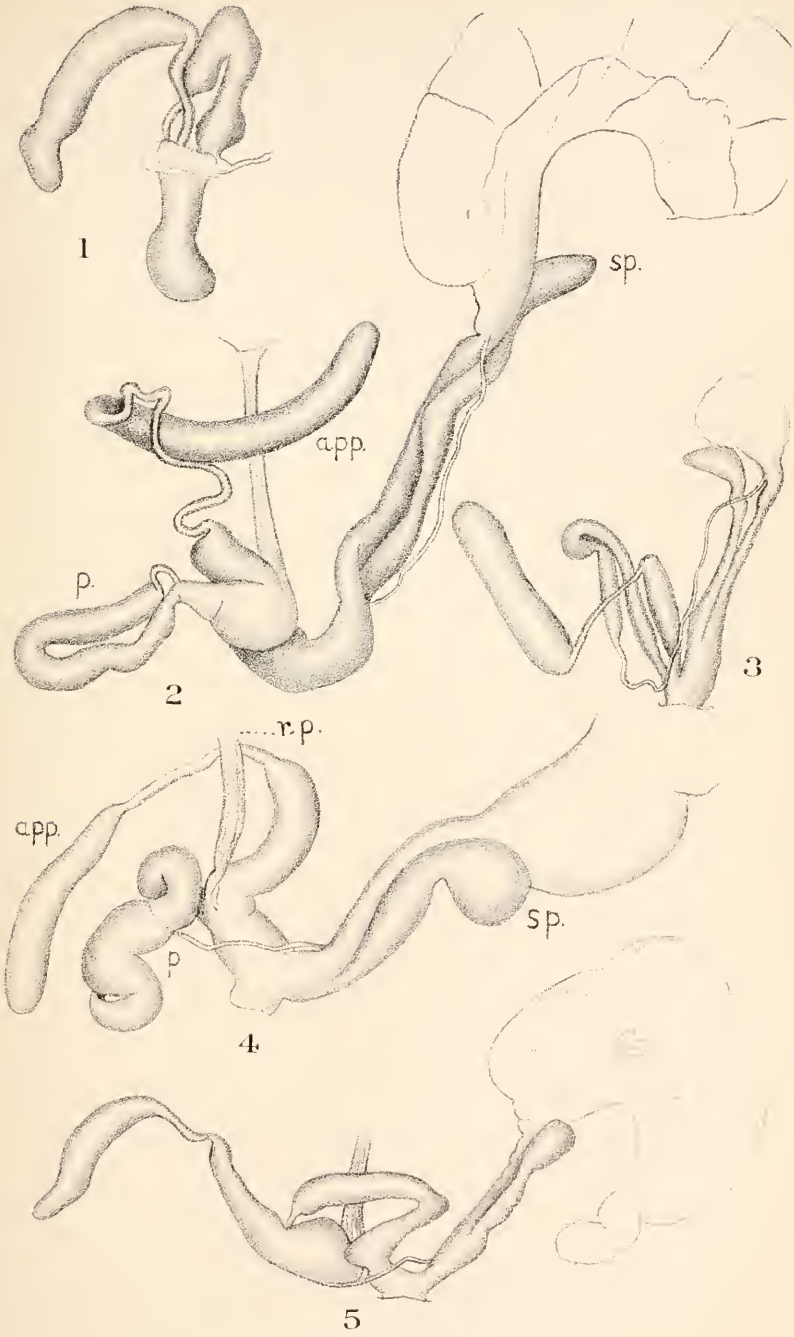
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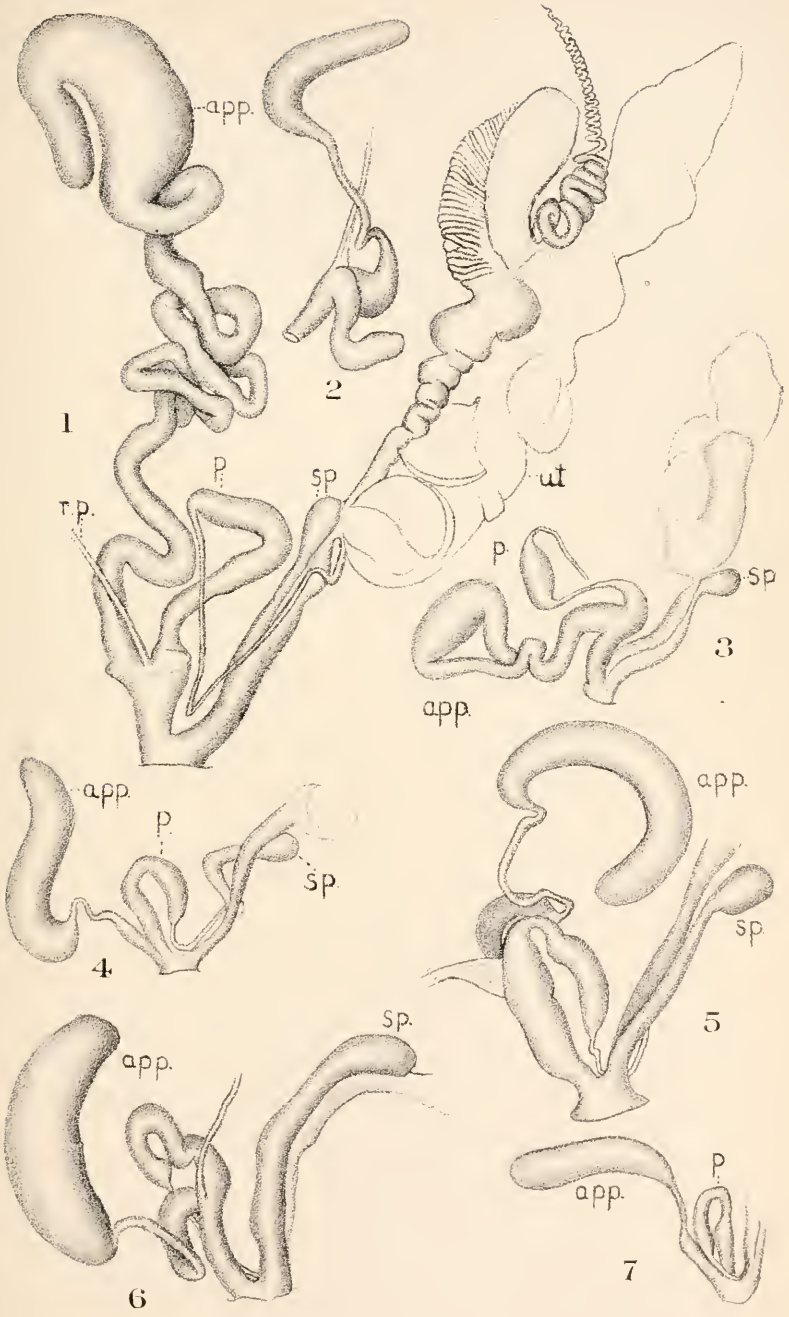
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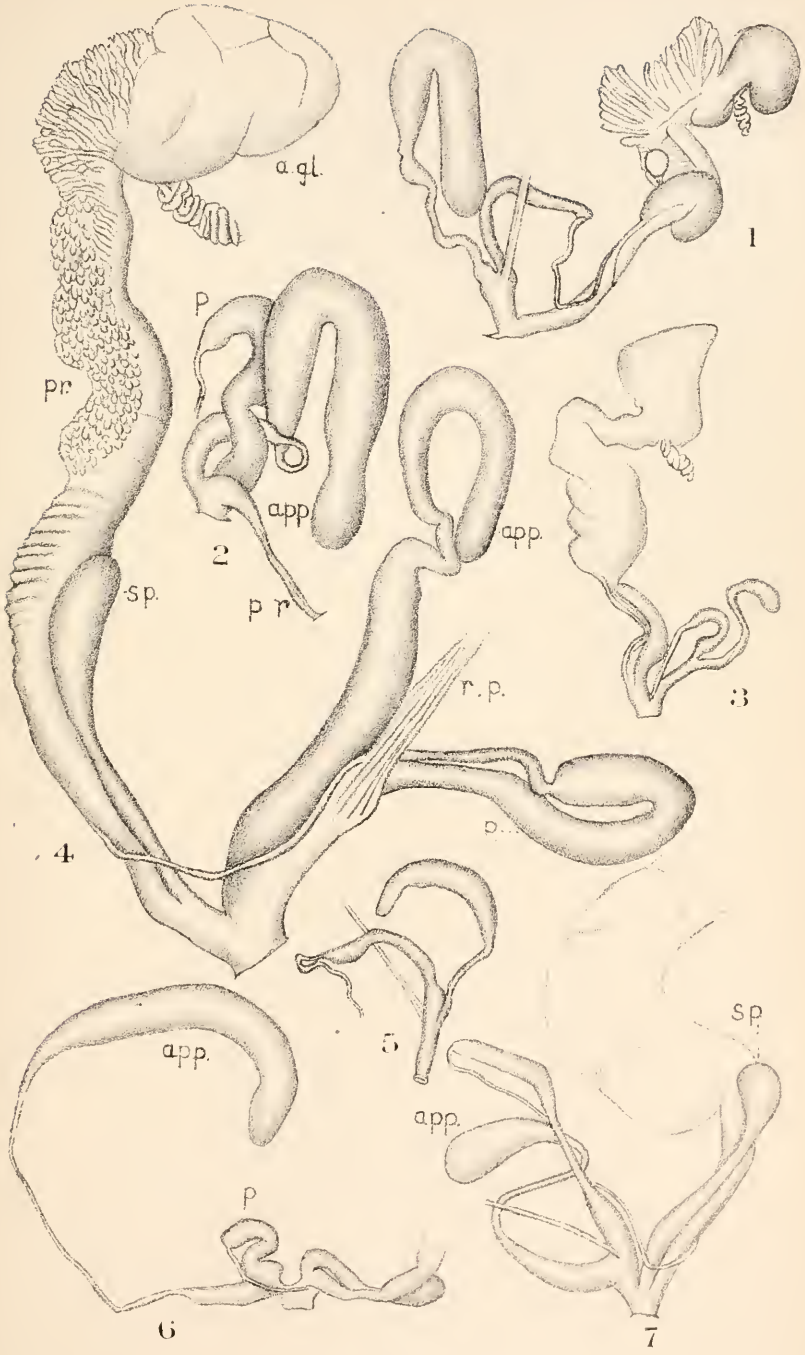
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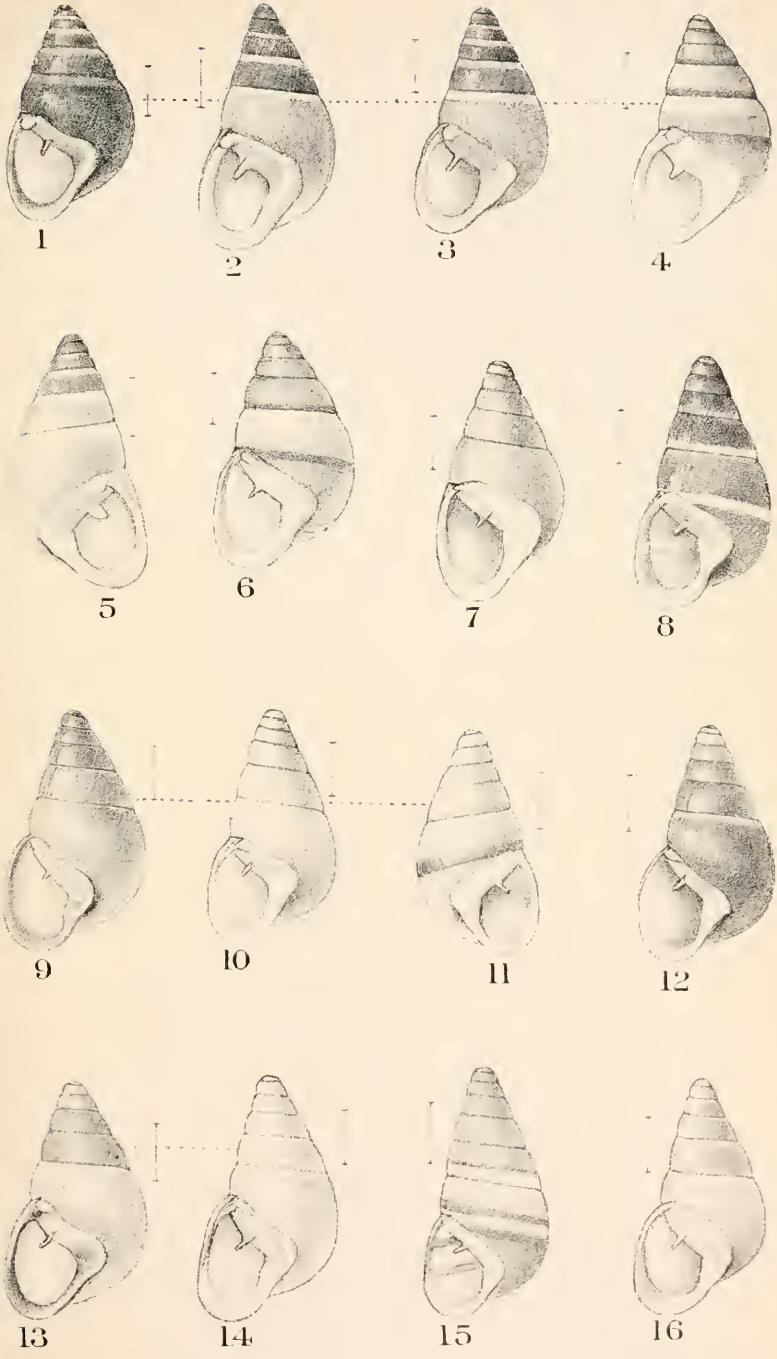
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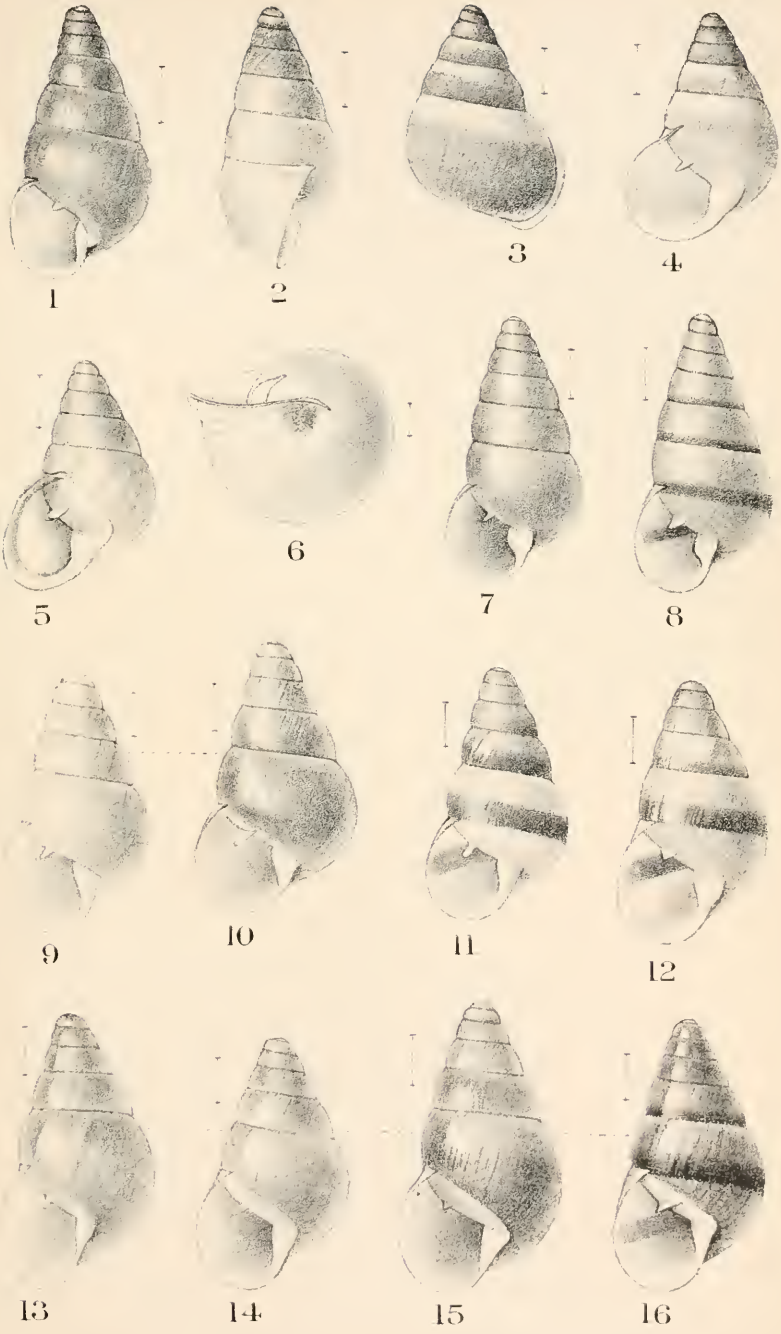
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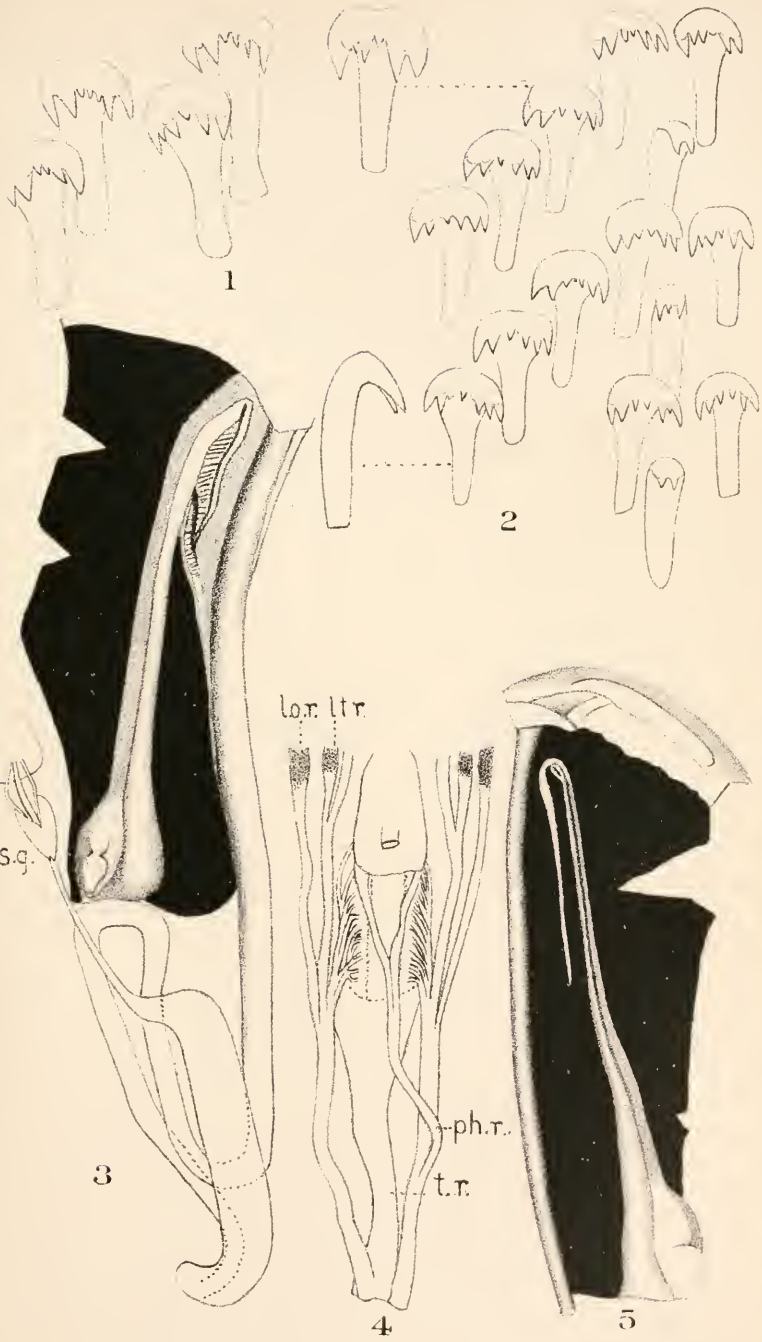
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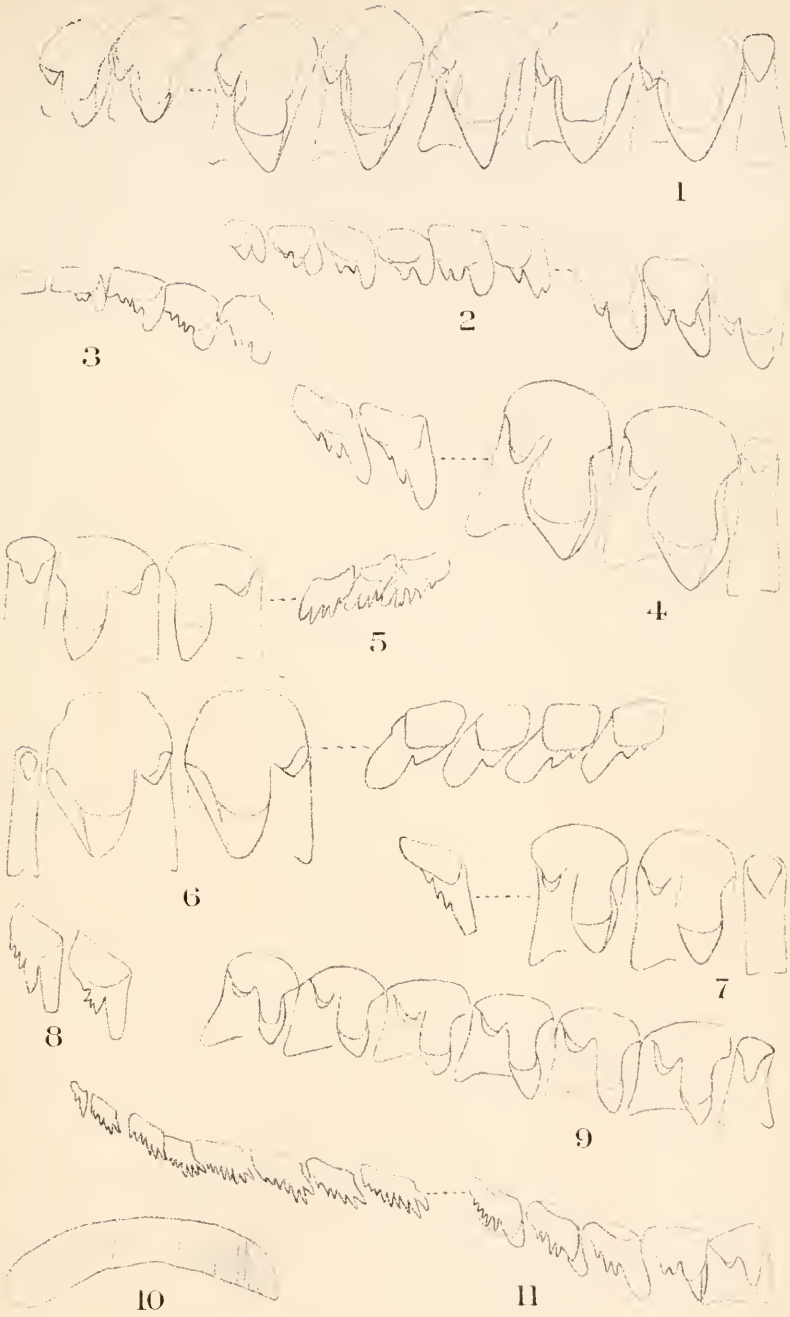
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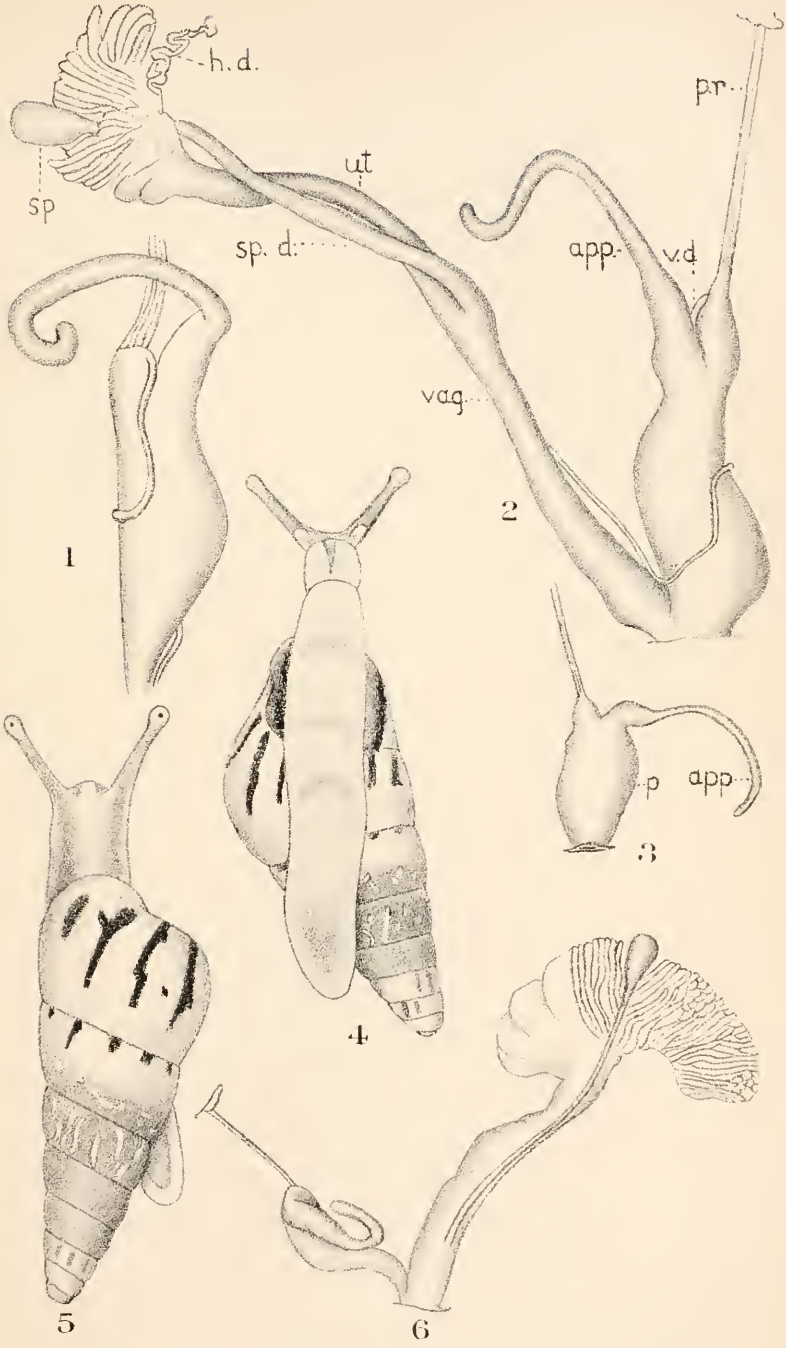
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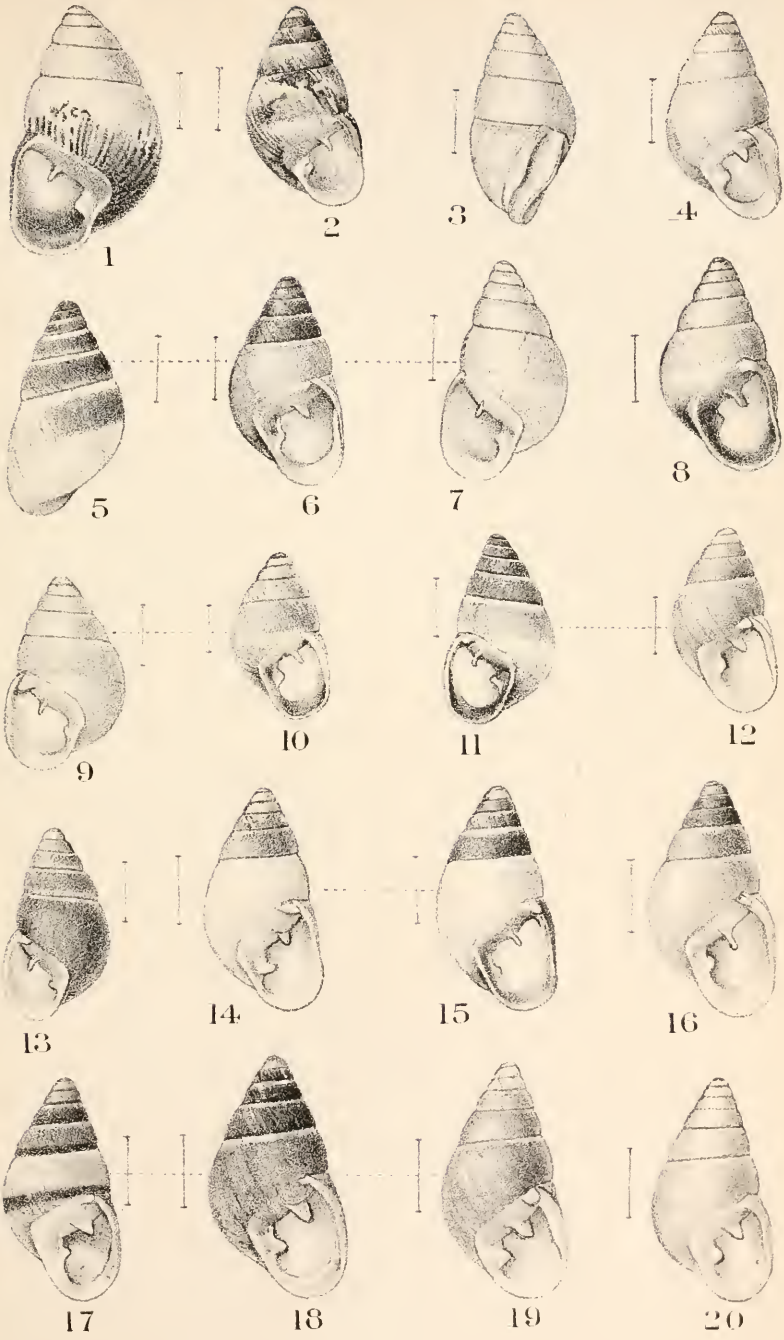
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oped than in *E. apertum* and *wakefieldiæ*, and while all are very closely related, *E. cernicum* seems to be distinguishable.

Pfeiffer placed his *T. mauritiana* as a synonym of *cernica* in the *Monographia*, where he substituted his description for that of Benson. "*Tornatellina mauritiana* Pfr. Shell ovate-conic, thin, smooth, pellucid, corneous; spire conic, somewhat obtuse; whorls 4½, a little convex, the last inflated, nearly equal to the spire; parietal lamella of the aperture median, compressed, entering; columella callus, glossy, with a high dentate truncation; aperture somewhat semioval; peristome simple, acute and straight. Length 4, diam. 2½, aperture 2 mm. long."

Species of the Caroline, Marianne and Japanese Islands.

12. E. OVATULUM (Moellendorff).

Shell imperforate, conoid-ovate, thin, pellucid, very delicately striatulate, a little glossy, pale buff. Spire short, conoid, the apex obtuse. Whorls 4, a little convex, parted by a crenulate suture, rapidly increasing, the last large, rather swollen. Aperture very oblique, oval; peristome unexpanded, acute, the columellar margin very narrowly reflexed, appressed. Parietal lamella rather elevated, spirally entering a long distance. Columella strongly twisted, at the base deeply excised bidentate. Alt. 3, diam. 2 mm. (*Mlldff.*).

Caroline Is.: Ponape (Etscheid).

Tornatellina ovatula MLLDFF., Journal of Malacology, vii, March 24, 1900, p. 114.

13. E. QUADRASI (Moellendorff).

Shell imperforate, ovate-globose, thin, pellucid, delicately striate, somewhat shining, pale buff-corneous; spire little elevated, the apex rather obtuse; whorls 3½, a trifle convex, rapidly increasing, the last large, swollen. Aperture moderately oblique, oval, peristome simple, acute; columellar margin very slightly reflexed, appressed. Parietal lamella strongly elevated, spirally entering. Columella strongly lamellarly dilated, deeply excised at the base in a right angle. Length 2.5, diam. 2 mm. (*Mlldff.*).

Marianne Islands (Quadras).

Tornatellina quadrasi Mlldff., Nachrichtsblatt d. Deutschen Malak. Gesellschaft, vol. 26, Feb., 1894, p. 16.

14. E. KITAIWOJIMANUM (Pilsbry & Hirase). Pl. 31, figs. 9, 11.

The shell is imperforate, globosely-ovate, thin, corneous, somewhat translucent. Surface shining, the first whorl very minutely roughened, second whorl microscopically and very closely striate spirally, the last whorl marked with minute growth-lines and very fine, rather widely-spaced impressed spiral lines. Spire short, obtuse. Whorls almost 4, strongly convex. The aperture is ample, oblique; outer lip fragile; parietal lamella extremely low and about a half-whorl long, columella abruptly truncate at the termination of the steeply, spirally-ascending columellar lamella, and above it bearing a low, more steeply ascending lamella.

Length 3.2, diam. 2.3 mm.

Japan: Kita-Iwo-jima, Sulphur group, and Hachijo, Izu-shichito group, Izu. Type no. 84965 A. N. S. P. (Hirase).

Tornatellina kitaiwojimana Pils. & Hir., Nautilus, xvii, Sept. 4, 1903, p. 53.

The columellar plate is narrow but distinctly biplicate; the parietal lamella low but long. Kita-Iwo-jima is one of the Sulphur or Volcano Islands, a little group lying south of the Ogasawara (Bonin) Islands, and in line with the Izushichito group, or so-called "Seven Islands of Izu." They were discovered by Bernard de Torres in 1543, and are governed by Japan from the Ogasawara Islands. Volcanic forces are still active in this group, which is regarded as a continuation of the Fuji chain, in which the species occurs also on Hachijojima.

This species has more convex, shorter whorls and a deeper suture than *E. apertum* and *E. cernicum*, and the parietal lamella is lower.

Genus LAMELLOVUM Pilsbry.

Lamellovum Pils., Nautilus, xxiii, March, 1910, p. 123, for *Tornatellina globosa*.

The shell is imperforate, broadly ovate, of rather numerous (about 6) whorls; parietal lamella *long*; columella thick, bearing *several deeply entering* lamellæ; palatal plicæ developed. Apical whorl small, spirally striated. Type *Lamellovum globosum*.

This genus is proposed for a peculiar species having the apertural armature much more complex than in *Elasmias*, the columella bearing numerous long, entering lamellæ. The whorls are more numerous and the apex smaller than in *Elasmias*. The eggs or young at birth must be relatively smaller than in *Elasmias*, on account of the very narrow spaces between the teeth.

1. L. GLOBOSUM (Petit). Pl. 28, figs. 9-12.

Shell ventricose-conic, pellucid, buff-greenish. Whorls 6 to 7, flattened, the last largest, ventricose, paler. Spire acutely conic. Aperture semilunar, ringent. Columella provided with a lamelliform tooth above the middle, margined by a tooth below, sometimes double, plicate at the base, the plica emarginate in front, bilobed, the upper lobe ascending, the lower subhorizontal; outer lip acute. Length 4, diam. 3 mm. (*Petit.*)

Shell globose-conic, rather solid, striatulate, greenish-buff; spire conic, rather acute; suture very slightly impressed; whorls 7, rather flattened, the last nearly as long as the spire, subglobose. Aperture elliptical-semioval, obstructed by four folds: one obliquely entering parietal fold, somewhat doubled below; a second strong, short, emarginate sub-bilobed on the columella, and two obsolete plicæ in the palate. Length 4 to 4½, diam. 3 mm.; aperture 2¼ mm. long (*Pfr.*).

Island of Opara [Rapa], under stones (Cuming).

Elasmatina globosa Petit de la Saussaye, P. Z. S., 1843, p. 2.—*Tornatellina globosa* Kuester, Conchyl. Cab., p. 154, pl. 18, figs. 26, 27.—Pfr., Symbolæ, iii, p. 60; Monogr., ii, p. 393; iii, p. 527; iv, p. 652; vi, p. 265.

In this peculiar shell the whorls are moderately convex, though the general outlines of the spire are straight. The surface is distinctly striate, the apex decidedly smaller than in typical *Elasmias*. The parietal lamella is about two-thirds of a whorl long. The inner half is quite low, but the outer is strongly developed, and has pairs of short lamellæ upon its lower face, also some projections above the edge on its outer face. The columellar lamella is long, thickened at the edge. Above and below it are quite small lamellæ (supracolumellar and intracollumelar), and the subcolumellar lamella is as strong but not as long as the columellar. Below it there is a very stout lamella, which does not reach far inward, but forms the lower margin of the columellar plate. Above and below the group of columellar lamellæ there are deep, narrow sinuses. There are six short, deeply placed, interrupted palatal plicæ. The basal lip is thick within. Length 3.7, diam. 3.2 mm.; 5¾ whorls.

Kuester's figure is copied in fig. 9. Figures 10-12 represent the specimen described above. Former descriptions do not notice all of the apertural lamellæ and folds. The apertural lamellæ do not all show in a front view (fig. 10). Fig. 12, an obliquely basal view, and fig. 11, view through a hole on the right side of the back, give a better idea of the structure.

Genus TORNATELLINA Pfeiffer.

Tornatellina Beck, Index Molluscorum, 1837, p. 80, nude name.—*Strobilus* Anton, Verzeichniss, 1839, p. 46. Not *Strobila* Sars, 1835, Medusæ, or of Sodoffsky, 1837, Lepidoptera. —"*Strombilus* Alton" Gray, P. Z. S., 1847, p. 175 (type *S. turritus*).—*Tornatellina* Beck, Pfeiffer, Symbolæ, ii, 1842, pp. 5, 55, 130.—Gray, P. Z. S., 1847, p. 175.—Pfr., Nomenclator Hel. Viv., 1878, p. 341.

The shell is small (usually 2 to 5 mm. long), dextral, ovate-conic or oblong-ovate, *imperforate at all stages of growth*, thin, uniform corneous or brown, the surface glossy, faintly marked with growth-lines. Aperture ovate; parietal lamella median, entering from one-fourth to a half-whorl (very rarely wanting); columella simuous, sometimes lamellate; outer lip

thin, simple; the palatal wall either smooth, toothed or laminate. Reproduction viviparous.

Type, *T. clausa* = *bilamellata*. Distribution, Islands of the Pacific, East Indies.

Tornatellina is now restricted to *imperforate* species. The allied umbilicate forms are placed in the genera *Tornatellides* and *Tornatellaria,* and the genus *Elasmias* is instituted for the globose forms with truncate columella.

Nomenclature.

Tornatellina was instituted by Beck (*Index Molluscorum,* 1837, p. 80) for four species, all new, and none of them described.

"1. T. clausa B., I. Opara.

"2. T. trochiformis B., I. Juan Fernan.

"3. T. trochlearis B., I. Mapasuera [Masafuera].

"4. T. archimedis B., I. Opara.

"*a. major.*

"*b. minor.*"

Since neither the genus nor any of the species were defined by a single word, Beck's action was ineffective. His *nomina nuda* in no way prejudice subsequent work on either genus or species.

Pfeiffer, in the *Symbolæ ad Historiam Heliceorum,* ii, 1842, defined the genus *Tornatellina* Beck (p. 5), and described the following species (p. 55): *Tornatellina clausa* Beck, *T. minuta* Ant., *T. trochiformis* Beck, *T. trochlearis* Beck. On p. 130 he gives a list of the known species: *Archimedis* B. (= *turrita*), *clausa* B., *cubensis* Pfr. (= *Achatina pellucida* Pfr., 1840), *ferussaci* Pfr., *minuta* Ant., *ovata* Ant., *owaihiensis* Cham., *trochiformis* B., *trochlearis* B.

This is the first publication of *Tornatellina* which can be recognized in nomenclature. Gray, in 1847, selected *T. clausa,* the first species of Beck's and Pfeiffer's lists, as the type. This species has been considered by Pfeiffer to be synonymous with *T. bilamellata* Anton. The subsequent selection of *trochlearis* as type, by von Martens (*Die Heliceen,* 1860, p. 259), was ineffective on account of the prior selection of *T. clausa* by Gray.

It is unfortunate that the type of *Tornatellina* is a little-known species from a peripheral locality (Juan Fernandez). We know nothing of the lingual dentition or of the stages of development of any species of this island. Their relations to the Tornatellinas of Polynesia and other regions remain to be determined.

If names differing from prior generic names only in gender are admitted, *Strobilus* Anton will have priority for the genus, if its type *S. turritus*, proves to be congeneric with the Tornatellinas, as we suppose. It will also replace *Elasmatina*, based upon the same species. We have not seen this species, which differs from the others by its lengthened shape and numerous whorls.

The tropical American genus *Leptinaria* and the genus *Ochroderma* closely resemble *Tornatellina* in shell characters, but the dentition is Achatinoid. The species are mostly larger than *Tornatellina*.

Species of other families described as Tornatellina.

Part of the species of all of the other genera of *Tornatellinidæ* were at first described under the generic name *Tornatellina*; also the following species belonging to other families:

Tornatellina striata Newcomb, 1861 = *Leptachatina*. Vol. xxi, p. 62.

Tornatellina cubensis Pfeiffer = *Blauneria*.

Tornatellina hierosolymarum Roth = *Calaxis*. Vol. xix, p. 285.

Tornatellina fraseri Bs. = *Ferussacia*. Vol. xix, p. 249.

Tornatellina ceylanica H. Nevill, Enum. Helic. Ceylon, 1871, p. 3; undescribed.

Numerous species of the genera *Leptinaria* and *Ochroderma* were described as *Tornatellina*. See Manual, vol. xviii, pp. 288 to 328.

Classification.

Tornatellina was divided, in 1910, into four sections with substantially the following characters:

a. Shell oblong-conic or ovate-conic; whorls less than 7.

b. Aperture having a parietal and a columellar lamella and two palatal plicæ or two spiral series of teeth, at least in the neanic stage. Section *Tornatellina*, species no. 1 to no. 12.

b^1. Aperture having a parietal and one to three columellar lamellæ, and successive vertical palatal ribs in the neanic stage, sometimes persisting in the adult stage. Section *Lamellina*, species nos. 13 to 24.

b^2. Columella sinuous, parietal wall lamellate; no palatal teeth or ribs at any stage of growth. Section *Tornatellinops*, species nos. 25 to 47.

a^1. Shell long-turrite or conic; whorls 9 or 10, flattened. Section *Elasmatina*, species nos. 48 to 51.

Adult individuals of the first two sections are phylogerontic in some species, becoming secondarily simplified in the adult stage, and indistinguishable from species of *Tornatellinops*. The classification of species known by the adult stage only is therefore uncertain in some cases.

Geographic Distribution and Keys to Species.

Species of Japan, the Loochoo and Bonin Islands.

a. Shell having a vertical rib or ribs within the outer lip; length 3 to 3.2 mm., with 5 to 5½ whorls.

b. Adult with strong lip-rib and no palatal ribs; columella thick, minutely biplicate; neanic stage with 2 or 3 columellar lamellæ and serrate palatal ribs. Ogasawara (Bonin) Is. *T. ogasawarana*, no. 13.

b^1. Adult with thin lip and a smooth palatal rib. *T. biplicata*, no. 14.

a^1. No palatal or lip ribs.

b. Shell rather obese, the diam. more than half of length.

c. Length about 3.3 mm.; 4½-5 whorls.

d. Parietal lamella low but long; Loochoo Is. *T. rucuana*, no. 26.

d^1. Parietal lamella wanting; Bonin Is. *T. monodonta*, no. 25.

c^1. Length about 2.2 mm., with 3½ whorls; parietal lamella low, ⅓ of a whorl long; Sulphur Is.
T. hataiana, no. 28.

b^1. Shell rather slender, the diam. less than half the length, parietal lamella strong; whorls 6; Bonin Is.
T. nakadai, no. 27.

Species of Micronesia (Caroline and Marianne Is.)

T. subcylindrica, no. 22; *T. microstoma,* no. 23; *T. moellendorffiana,* no. 24; *T. ponapensis,* no. 29.

Hawaiian Species.

a. Diameter more than half the length.

b . Young usually with one or two palatal folds; columella strongly sinuous. *T. baldwini,* no. 5.

b^1. Young without palatal folds.

c. Shell ovate; columella weakly sinuous.
T. mcgregori, no. 6.

c^1. Shell subcylindrical or narrowly ovate.
T. gayi, no. 30.

a^1. Diameter less than half the length.

b. Parietal lamella straight in section, not flaring outward.

c. Parietal lamella very broad, subhorizontal; no palatal ribs in the young; length 2½-3 mm., 4⅔-5 whorls. *T. tantalus,* no. 31.

c^1. Parietal lamella moderately developed; young with palatal ribs.

d. More than 3 mm. long. *T. oblonga,* no. 20.

d^1. Less than 3 mm. long. *T. cylindrica,* no. 15.

b^1. Parietal lamella strong, flaring outward, arcuate in section.

c. Last whorl flattened, with a shallow, broad, peripheral depression.

d. Aperture elongate, shell vitreous.
T. lanceolata, no. 18.

d^1. Aperture small, shell brownish-corneous.
T. gracilis, no. 19.

c^1. Last whorl convex, without depression.

d. Columella strongly twisted in the adult.

T. polygnampta, no. 16.

d^1. Columella weakly twisted. *T. peponum,* no. 17.

Polynesian Species.

a. Shell oblong-turrited, of 9-10 whorls; Rapa.

T. turrita, no. 51.

a^1. Shell oblong-conic or ovate-conic, of 7 whorls or less.

b. Columellar lamella superposed upon the spiral fold; at least in the young; two palatal plicæ or successive pairs of teeth, sometimes wanting in the adult stage.

c. Length 4½ to 5 mm., diam. 2 to 3 mm., whorls 6-7; usually two palatal teeth or short, entering plicæ. T. *bilamellata,* no. 1; *T. hidalgoi,* no. 2; *T. gouldi,* no. 4.

c^1. Smaller, length 2.5 to 3, diam. 1 to 1.6 mm.; whorls 5-6. Columella having palatal teeth in pairs or in one spiral series, sometimes wanting in the adult stage.

d. Columellar lamellæ 3, an oblique fold above and a small denticle below the median lamella.

e. Columellar lamella prominent in a front view; usually having palatal teeth in pairs. *T. perplexa,* no. 7.

e^1. Columellar lamella immersed; a low callous streak in the palatal region.

T. societatis, no. 10.

d^1. One prominent columellar lamella, with a more or less obvious fold above it, but no denticle below it.

e. Whorls convex; columellar lamella deeply placed.

f. Length 2.8, diam. 1.6 mm.; Fiji Is.

T. columellaris, no. 11.

f^1. Narrower, length 3.2, diam. 1.5 mm.

T. nitida, no. 8.

e^1. Whorls nearly flat, the sides of spire planulate. *T. micans,* no. 9.

b^1. Palatal wall bearing vertical ribs.

c. Diameter less than half the length. *T. oblonga, juv.,* no. 20.

c^1. Diameter over half the length. *T. serrata,* no. 21.

b^2. No palatal plicæ, teeth or ribs, and no columellar lamella.

c. Diameter less than half the length. *T. oblonga,* no. 20.

c^1. Diameter about equal to or exceeding half the length.

d. Whorls plano-convex; 2.7 x 1.5 mm. *T. affinis,* no. 35.

d^1. Whorls moderately convex, 3 x 1.5 mm. *T. voyana,* no. 37.

d^2. Whorls rather strongly convex. *T. pusilla,* no. 33; *T. impressa,* no. 32; *T. philippii,* no. 36; *T. trochlearis,* no. 35.

Australia, New Zealand, Melanesia.

Australia, *T. jacksonensis,* no. 41. Torres Straits, *T. mastersi,* no. 42. New Zealand, *T. novoseelandica,* no. 40. New Caledonia, *T. noumeensis,* no. 43. Kermadec Is., *T. kermadecensis,* no. 12; *T. iredalei,* no. 38; *T. raoulensis,* no. 39.

East Indies, Philippines.

T. ringens, no. 3; *T. camarinica,* no. 46; *T. kochiana,* no. 44; *T. moluccana,* no. 45.

Juan Fernandez, Masafuera.

T. bilamellata, no. 1; *T. reclusiana,* no. 49; *T. conica,* no. 50; *T. trochiformis,* no. 51; *T. minuta,* no. 47; *T. trochlearis,* no. 35.

Undescribed species of *Tornatellina* (in the old sense) have been reported from Ceylon (*T. ceylanica* H. Nevill) and Shanghai. See G. Nevill, Handlist of Mollusca in the Indian Museum, i, p. 160, 1878. These species may perhaps belong to *Elasmias* or *Tornatellides.*

Section TORNATELLINA *s. str.*

Tornatellinæ in which there is a strong, subhorizontal columellar lamella superposed upon the columellar fold; palatal teeth or plicæ usually in vertical pairs, often standing on a vertical callus, or scattered in two, an upper and lower, series. Type *T. bilamellata* Anton.

The columellar lamella is sometimes immersed and visible only in an oblique view in the mouth.

Two groups of species are placed here, one contains rather large species; the other (group of *T. perplexa*) consists of small fragile forms, which in characters reach out towards *Lamellina*.

Group of T. bilamellata.

Four comparatively large forms which have never been directly compared compose this group. Coming from widely separated localities, they will probably prove to be distinct though similar species. The immature stages are unknown.

1. T. BILAMELLATA (Anton). Pl. 34, figs. 9, 10.

Oval, conoidal, 5 to 6 flat whorls, the last half the total length, apex acute. Aperture long oval, very narrow, with two lamellæ on the columella and two delicate cords on the anterior wall of the aperture. Glossy, transparent, extremely delicate, brownish. Length 2½, diam. 1¼ lines (*Anton*).

Shell ovate-conic, very thin, striatulate, glossy, pellucid, corneous. Spire conic, the apex acute. Whorls 6 to 7, the last about three-sevenths the total length, rotund at base. Aperture elliptical, narrow, obstructed by a moderate, suboblique entering lamella on the parietal wall, a strong transverse columellar fold and two delicate parallel palatal laminæ. Peristome acute. Length 5, diam. 3, aperture 2.5 mm. long (*Pfr.*).

Opana (Rapa or Opara) Island (Anton). Juan Fernandez (Pfr.; Challenger Exped.).

Strobilus bilamellatus ANTON, Verzeichniss etc., 1839, p. 46, no. 1694.—*Tornatellina clausa* BECK, Index Moll., 1837, p. 80, *teste* Anton.—PFR., Symbolæ ad Hist. Hel., ii, p. 55.—

T. bilamellata Anton, Kuester, Conchyl. Cab. Pupa, p. 147, pl. 18, f. 3 to 5.—H. & A. Adams, Genera of Recent Moll., p. 140, pl. 74, f. 4.—Pfr., Monogr., ii, 393; iii, 527; iv, 652; vi, 265; viii, 319.—E. A. Smith, P. Z. S., 1884, p. 280.—not of Schmeltz, Godeffroy Catal., v, p. 90.

In the last volume of the *Monographia,* Pfeiffer gives the locality Juan Fernandez, and this has been confirmed by E. A. Smith. It is highly improbable that the same species occurs in both of the islands mentioned. The figure is from Kuester.

The original description of *T. clausa* follows:

"*Tornatellina clausa* Beck, p. 80.—*Strobilus bilamellatus* Ant., p. 46.—Shell ovate-conic, pellucid, corneous, very thin, striolate; whorls 6, flat, the last shorter than the spire; aperture oblique, oval; peristome simple. Length 5½, diam. 3 mill.—Opara (Anton)." (*Pfr.*, 1842.)

2. T. hidalgoi Crosse. Pl. 33, figs. 7, 9.

Shell imperforate, oblong-conic, thin, a little shining, pellucid, chestnut-corneous. Spire rather long, the apex a little obtuse, rounded. Whorls 6, slightly convex, slightly striatulate obliquely, nearly smooth, the last whorl a little shorter than the spire, rotund, tapering at base. Aperture somewhat oblique, semioval, obstructed by a large, spirally directed, deeply entering, white parietal lamella. Columellar margin thickened within, white, having a strong white somewhat irregular fold. Outer lip simple, acute; palatal wall armed with two deeply placed white teeth joined by a callus. Length 4½ to 5, diam. 2 mm. (*Crosse*).

Gambier Islands (Paz).

Tornatellina hidalgoi Crosse, Journ. de Conchyl., xiii, 1865, p. 219, pl. 6, f. 6.—Pfr., Monogr., vi, 266.—Garrett, Proc. A. N. S. Phila., 1879, p. 25, last paragraph.

Somewhat related to *T. perplexa* Garrett, but decidedly larger, with the columellar armature somewhat different. It is probably closely related to *T. bilamellata.* Garrett remarks that specimens from the Gambier Is. in his possession have two palatal teeth like Crosse's type, "or have simply from one to two spiral rows of denticles in the palate."

3. T. RINGENS Dohrn. Not figured.

Shell conic, rather thin, striatulate, fulvous-corneous. Spire conic, acute; suture impressed. Whorls 7, a little convex, slowly increasing, the last subangular in the middle, at the base slightly depressed. Aperture rhombic-elliptical, obstructed by 4 or 5 folds: 1 on the parietal wall, oblique, strong, compressed, crested; 1 or 2 columellar, varying; 1 or 2 palatal plicæ, the lower compressed, upper tuberculiform. Length 5½, diam. 3, length of aperture 2¼ mm. (*Dohrn*).

Philippine Islands (A. Fokkes in coll. O. Semper).

Tornatellina ringens DOHRN, Malak. Blätter, x, 1863, p. 161. —PFR., Monographia Hel. Viv., vi, 265.

It agrees remarkably in figure with *T. philippii*, but the dentition is wholly different. The parietal fold is alike in the two species. The columella in our species is calloused and bears one or two lamellæ of unequal size, the upper being much smaller and deeply-seated, sometimes wholly vanishing, the lower very strongly developed, callous, generally bifid within, seldom simple inside and bifid outwardly (as Pfeiffer described for *T. gouldi*). There are also two palatal teeth standing on a transverse callous, the lower tooth compressed, the upper small, tubercular, sometimes disappearing. The callous is deposited anew at various periods of growth (*Dohrn*).

4. T. GOULDI Pfeiffer. Not figured.

Shell ovate-conic, thin, smoothish, pellucid, corneous. Spire long-conic, the apex rather obtuse. Whorls 5½, convex, the last nearly two-fifths the length, rotund. Aperture oblique, erect-lunar, obstructed by a strong entering parietal lamella and a thick subtriangular columellar fold. Peristome unexpanded, thin. Length 4, diam. 2.5 mm., aperture 2 mm. long (*Pfr.*).

Habitat unknown (Cuming coll.).

Tornatellina gouldi PFR., P. Z. S., 1856, p. 335; Monogr., iv, 651.

"Similar to *T. philippii*, from which it differs chiefly by the prominent subtriangular columellar fold" (*Pfr.*). Known

to us by the original description only. It is not certainly known to belong to the *bilamellata* group.

Group of T. perplexa.

Small, delicate species, very similar to those of the section *Tornatellinops*, from which they differ by having an acute lamella superposed upon the weak columella fold. They differ from *Lamellina* by lacking well-developed vertical ribs within the palatal wall, yet in some species the two groups are scarcely distinguishable. The delicate palatal denticles are often absent in adult shells. The neanic stage is like the adult in *perplexa* and *nitida*.

5. T. BALDWINI Ancey. Pl. 35, figs. 3, 4; pl. 40, fig. 13; pl. 42, figs. 1, 2.

Shell oblong-ovate, imperforate, thin, pellucid, corneous, glossy, under a lens slightly striatulate. Spire conoid, a little longer than the aperture, the summit subacute. Whorls 4, convex, rapidly increasing, the last oblong. Aperture acutely oblong-ovate, hardly compressed outwardly, bearing a rather minute revolving lamella on the parietal wall. Columella thickened, whitish, toothless, obliquely twisted, continued into the anterior margin. Length 2.5, diam. 1.5, length of aperture 1.2 mm. (*Ancey*).

Kauai (Baldwin, Cooke); Oahu: Manoa (Baldwin), Tantalus (Baldwin, Cooke), Nuuanu (Cooke), Waianae Mts. (Perkins, Cooke): Maui: Kaupakalua and Keanae (Baldwin); Hawaii (Thaanum). In the pleistocene of Oahu at Kaelepulu, Kailua, Laie and 1½ miles W. of Kahuku.

Tornatellina baldwini ANC., Bull. Soc. Malac. France, vi, 1889, p. 238; Journ. de Conchyl., li, 1903, p. 296, pl. 12, figs. 1, 2.—SYKES, Fauna Hawaiiensis, Moll., p. 380.

"The specimen from Oahu which served for the description was not fully developed. In the adult stage the species is a little larger, with one whorl more, and the spire is a little longer. The characters of the aperture remain the same" (*Ancey*). Mr. Ancey's figures are copied, pl. 35, figs. 3, 4.

This species and *T. megregori* are more obese than other

imperforate Hawaiian Is. species, with fewer whorls. A specimen in the collection of the A. N. S. P. measures, length 3.25, diam. 1.75, aperture 1.25 mm. The parietal lamella is very low and about one-third of a whorl long. Reduction of the parietal lamella to a greater or less extent is characteristic of the species; it is always short in the adult, a little larger and stronger in the neanic stage. The columella is strongly twisted, thin; and the striation is distinct. Whorls 4½. A slightly larger specimen in the collection of the Bishop Museum has 4½ whorls and is 3.5 mm. in length. Ancey's type specimen, B. P. Bishop Museum coll., no. 18422, is from Manoa, Oahu.

In an embryonic specimen the shell is imperforate. Under a high-power lens the surface is minutely granulate. The columella is almost straight, not swollen as in *T. mcgregori* and there is no sign of the median columellar lamella. The parietal lamella is very minute, much smaller than in *T. b. subrugosa* or *T. mcgregori.*

Most of the young, at about the metaneanic stage, have a short, lower palatal fold. Some specimens (pl. 40, fig. 13, Kaelepulu) have, in addition, a second palatal fold opposite the margin of the parietal lamella. The columella at the metaneanic stage is almost straight, twisted, and is furnished near the middle with a rather strong almost transverse fold. The parietal lamella is rather strong, scarcely bent in cross section, and its margin is very slightly sinuous. The specimen figured in pl. 42, fig. 2, is 2.25 mm. in length and has 4 whorls.

5*a*. *T. b. subrugosa*, n. var. Pl. 35, figs. 7, 10.

A series of shells from Maui (no. 98050 A. N. S. P.) differs from typical *T. baldwini* by having low, widely and unequally spaced narrow folds or wrinkles in the direction of the growth striæ. The columella is strongly twisted much as in *T. gracilis.* The parietal lamella is moderately high but *very short*, ¼ to ⅓ of a whorl long. The figured specimen measures 2.8 mm. long, 1.55 diam., length of aperture 1.3 mm.; but an imperfect shell is much larger. It is an extremely fragile form. An embryonic shell, taken out of the mouth of an old one, is

globose, imperforate, with a small lamella or denticle in the middle of the columella fold (pl. 35, fig. 7).

6. T. MCGREGORI P. & C., n. sp. Pl. 35, figs. 14, 15.

Shell ovate, brown, very fragile, rather glossy, marked with growth-wrinkles. Whorls convex. Columella slightly sinuous, but very much less so than in *T. baldwini*; in an oblique view in the aperture it appears nearly straight. *Parietal lamella inconspicuous, very small and thread-like,* far more reduced than in *T. baldwini.* Length 2.8, diam. 1.65, length of aperture 1.25 mm.

Hawaii: Hilo, under guava leaves (R. C. McGregor, 1900; H. W. Henshaw), types no. 85387 A. N. S. P.

In large series of shells of all ages taken by Mr. McGregor removed from one of the larger shells is figured (pl. 35, fig. 15). It has a rather strongly convex columellar fold, but no lamella superposed upon it, such as there is in *T. b. subrugosa,* The columellar fold is much broader than that of embryos of typical *T. baldwini.*

In large series of shells of all ages taken by Mr. McGregor and by Mr. H. W. Henshaw, none of the young have any trace of the palatal fold found in *T. baldwini.* The whorls of *T. mcgregori* are less convex and more closely coiled than those of *T. baldwini.*

7. T. PERPLEXA Garrett. Pl. 34, figs. 12, 13.

"Shell small, oblong-conic, imperforate, fragile, glossy, pellucid, smooth, pale brownish-horn color; spire oblong-conic, with subplanulate outlines; apex obtusely rounded; suture distinctly linear; whorls six, convex, moderately and regularly increasing, the last convexly rounded not deflected in front; aperture oblique, ovate-lunate, about one-third the length of the shell; peristome thin, straight, regularly curved; columella depressed, tortuous, bidentate, the basal tooth small, the upper, which is submedial, is larger and prominent; parietal region with a large, prominent, curved lamina; palate garnished with more or less numerous irregularly disposed denticles. Length 2¾, major diameter 1 mm" (*Garrett*).

Austral Is.: Rurutu (type loc.; Ch. De Gage). Cook's or Hervey Is. Society Is.: not uncommon, and ranges throughout the group (Garrett).

Tornatellina perplexa Garrett, Proc. Acad. Nat. Sci. Phila., 1879, p. 24; Journ. Acad. Nat. Sci. Phila., 1881, p. 398; ix, 1884, p. 82, pl. 2, f. 23.—*Tornatellina bilamellata* Schmeltz (not of Anton), Cat. Mus. Godeffroy, v, p. 90.

The columella is tridentate, there being a high, acute median lamella, and two subequal and much smaller denticles, one above and another below. In adult shells the upper and lower denticles can be seen only in an oblique view in the aperture, as in pl. 34, fig. 12, and pl. 36, fig. 2; but in the young (neanic) stage the three lamellæ are noticeable in a front view. This structure separates *T. perplexa* at once from *T. nitida*, which is otherwise related.

Garrett writes: "Some examples have the palatal denticles mounted on delicate, longitudinal lines of callus; others have the internal teeth so distinct as to give the aperture a ringent appearance. Cook's Island examples sent to the Museum Godeffroyanum were erroneously referred to Anton's *T. bilamellata*, a species twice the size of this."

8. T. nitida Pease. Pl. 36, figs. 3, 7; pl. 34, fig. 11.

The shell is turrite, with straight sides, very thin, clear yellowish corneous, rather transparent, glossy, faintly marked with slight growth-wrinkles. Composed of 5½ moderately convex whorls, parted by a very narrowly margined suture; the last whorl convex. Aperture small, oblique. Outer lip simple, fragile. Columella somewhat thickened, sigmoid, spirally twisted, grooved around the insertion, and encircled with a sharp, thin median lamella superposed upon the columellar callus, and so deeply placed that in adult shells it is visible in oblique view only. The parietal lamella is strong and extends inward half a whorl. In the palate there are frequently one or two spiral rows of small compressed denticles. Length 3.2, diam. 1.5 mm., aperture 1.1 mm. (Huaheine specimen).

Marshall Group: Ebon Island (Andrew Garrett, type loc.).

Society Is.: Huaheine; and Austral Is.: Rurutu (Garrett). Hervey Is.: Mauiki (C. D. Voy), Raratonga (Garrett). "Found abundantly on all of the islands in southeastern Polynesia" (Garrett).

Tornatellina nitida PEASE, Proc. Zool. Soc., 1860, p. 439; Journ. de Conch., 1871, p. 93; Proc. Zool. Soc., 1871, p. 473.—Pfeiffer, Mon. Hel., vi, p. 264.—GARRETT, Journ. A. N. S. Phila., ix, 1884, p. 83, pl. 2, f. 24; Proc. Acad. Nat. Sci. Phila., 1879, pp. 22, 26 (Rurutu); Journ. Acad. Nat. Sci. Phila., 1881, p. 399 (Hervey Is.).

This species is distinguished by the short but high and acute lamella superposed upon the columellar fold, and only visible in an oblique view in the aperture. It differs from *T. conica* by the columellar lamella. Half-grown and young shells down to 1.5 mm. long are like the adults except that the columellar lamella emerges, and in those under 2 mm. long we notice no palatal denticles. *T. columellaris*, which we know only from Mousson's description, seems to be a broader shell, but otherwise it must be very closely related. *T. perplexa* Garrett is closely related to *nitida*, but it has a triplicate columella, while in *T. nitida* there is no subcolumellar denticle.

Within the aperture there are often compressed palatal denticles, arranged in pairs, vertically. In some shells there are several such pairs. In other individuals there may be several denticles strung along in a single spiral series. Pl. 36, figs. 3, 7, represent examples from Huaheine. In pl. 34, fig. 11, a specimen from Mauiki, Hervey Is., is shown in back view, showing the internal teeth through the shell, which measures 2.7 x 1.4 mm.

Pease's description of this shell is not very satisfactory. He probably had some other species mixed with the *nitida*. Garrett, in 1879, gave a new description of *nitida*, fixing the name on the present species. His identification is in all probability correct, and may be accepted pending new collections from Ebon Island, or an examination of Pease's type. The original description follows:

"*Tornatellina nitida*.—Shell small, ovately turreted, thin, fragile, of a light horn-color, whorls six, rounded; last whorl

flattened and slightly depressed around the middle; aperture small, ovate, less than one-half the length of shell; outer lip simple, acute, slightly contracted at the middle; plait on inner lip prominent; base of the columella slightly reflected over the umbilical region and furnished with one or two plaits or tooth-like projections'' (*Pease*).

9. T. MICANS Garrett.

''Shell small, imperforate, ovate-conic, transparent, thin, polished, faintly striate under the lens, pale brownish-horn color; spire subacute, oblong-conic, *sides planulate*; suture distinctly and narrowly marginate; whorls six, *sub-planulate*, slowly and regularly increasing, the last rather large, not descending in front; aperture oblique, ovate-lunate, more than a third the length of the shell; parietal wall with a prominent, strongly compressed lamina; peristome thin, simple, regularly curved; columella slightly twisted, depressed, armed with a sub-median, nearly horizontal, acute tooth-like fold; palate with numerous irregularly disposed denticles.

Length 2½, major diameter 1½ mm.

Austral Is.: Rurutu (De Gage).

Tornatellina micans GARRETT. Proc. A. N. S. Phila., March 25, 1879, p. 23.

''A single example before me differs so much from any other species, that, after some hesitation, I have concluded to describe it as new.

''It is shaped almost precisely like *affinis*, but has the palatal denticles, and acute, columellar, tooth-like plait of *nitida*'' (*Garr.*).

This species will be recognized by its flattened whorls.

10. T. SOCIETATIS n. sp. Pl. 36, fig. 1; pl. 35, figs. 8, 11.

The shell resembles *T. nitida* in shape, is light brown with some whitish streaks on the last whorl, marked with weak growth-lines, glossy. In front view the columella is rather strongly sigmoid, as in *T. nitida*; but viewed obliquely in the mouth there is seen to be an oblique, spirally entering columellar fold above, then a rather acute columellar lamella, and

below it a callus bearing a small tubercular tooth. This structure resembles *T. perplexa* except that the lamella and tooth are not quite so strong in *T. societatis*. Some distance within the outer lip there is a very low, whitish, vertical, callus streak, occupying the position of the callus rib in *Laminella*. Parietal lamella well-developed, entering about a half-whorl, of about uniform height, its edge even. Length 3.25, diam. 1.55 mm.; aperture 1.2 mm.

Society Islands: Raiatea (C. D. Voy), type no. 83155 A. N. S. P.

This form differs from *T. nitida* by its tridentate columella and the very low callus in the palatal region, in place of denticles. In *T. perplexa* the columellar lamella is prominent in the adult stage in a front view, but in *societatis* it is immersed. It must be admitted, however, that specific relations in the *perplexa* group are only imperfectly understood. We have not the large lots containing shells in all stages of growth which are essential to an adequate understanding of the group. Meantime, the form defined above seems to be distinct from the allied species. It seems intermediate between the *perplexa* group and *Lamellina*.

11. T. COLUMELLARIS Mousson.

Shell imperforate, elongate-conic, pellucid, slightly striatulate, glossy, pale corneous. Spire regular conic, the summit rather acute, minute; suture impressed, simple. Whorls 5, rapidly increasing, convex, the last not descending, larger, a little swollen above and below, not impressed in the middle. Aperture slightly oblique (20 degrees with axis), scarcely one-third the length, oval. Peristome unexpanded, acute; margins not approaching, the right margin arcuate, columellar margin adnate above. *Columella bearing an acute, subhorizontal, deeply placed fold*, continued forward in the somewhat thickened margin. Length 2.8, diam. 1.6 mm. (*Mouss.*).

Fiji Is.: Kanathia (Dr. Graeffe).

Tornatellina columellaris MOUSS., Journ. de Conchyl., 1870, p. 129.—PFR., Monogr., viii, 316.

In general form this species resembles *T. conica*, with which the major part of the description also agrees. In the three examples observed, the spire is a little less elevated, and the last whorl is relatively larger. The chief difference between the species is in the columella, which in *conica* forms a weak subvertical cord, but in *columellaris* an acute lamella revolves about the columellar column, without reaching the edge. In one of the specimens there is a vertical series of three little dentiform granules some distance within the aperture.

The above description and observations, somewhat abbreviated from Mousson, show that *T. columellaris* is a form closely related to *T. nitida*, from which it differs by its shorter, broader shape. The internal teeth, which Mousson thought were probably pathologic, are apparently vestigeal structures in both of these species, being present only in certain individuals, or at certain stages of growth.

12. T. KERMADECENSIS P. & C., n. sp. Pl. 39, figs. 1 to 5.

The shell is imperforate, oblong-conic, yellowish-corneous, glossy, composed of 5¼ rather strongly convex whorls, the last not compressed peripherally. Aperture irregularly ovate; parietal lamella strongly developed, at least a half-whorl long, straight in section. Columellar lamella median, very strong, deeply entering; a small, obtuse fold visible above it in oblique view. Palatal wall bearing several pairs of teeth, which are slightly lengthened in a spiral direction, and are visible through the shell. Length 3.3, diam. 1.6, aperture 1.2 mm.

In the paraneanic stage (figs. 4, 5) the parietal lamella has an outward-flaring median lobe, and there are distinct, blunt, teeth above and below the median columellar lamella.

Kermadec Is.: Sunday Island (Tom Iredale). Type to be deposited in the Canterbury Museum, Christchurch, N. Z.; paratype in coll. A. N. S. P.

While very closely related to *T. perplexa*, this species is noticeably stouter in figure from the apex on; yet possibly it should be ranked as a subspecies of that Polynesian shell.

Section Lamellina Pease.

Lamellina Pease, Proc. Zool. Soc. London, 1860, p. 439, for *L. serrata* Pse.—*Lamellidea* Pilsbry, Nautilus xxiii, March, 1910, p. 123, type *T. peponum* Gld.

Tornatellinæ in which there are one to three vertical palatal ribs, either smooth or serrate, placed at intervals in the last whorl, in the neanic stage, often wanting in the adult; columella armed with two or three folds or lamellæ, at least in the neanic stage. Type *L. serrata.*

In this section the palatal ribs are vertical, while in *Tornatellina* the plicæ or series of teeth are spiral; but the *T. perplexa* group forms a partial transition.

The shells are small, up to 3.5 mm. long, thin and delicate. They live in the Bonin and Hawaiian Islands, Polynesia and Micronesia, but have not been found in Melanesia or Australia.

The section *Lamellidea* was designed to include Tornatellinæ with simply folded columella and no palatal armature at any stage of growth; but the type-species, *T. peponum,* proves to pass through a *Lamellina* stage. *Lamellidea* therefore becomes a synonym of *Lamellina.*

Lamellina is a group possessing a complicated aperture-armature in various stages of decadence. In all of the species upon which we have information, the teeth and folds reach their acme in the neanic stage, later development being more or less retrogressive or phylogerontic. In *T. serrata* the adult stage shows but slight diminution in the lamellæ and folds. In *T. ogasawarana, T. microstoma* and *T. polygnampta* the armature reaches its fullest development early in the neanic stage and in the ephebic or adult stage all characteristic structures of *Lamellina* are lost, and there is a return to the simplicity of *Tornatellinops.* The relations of such forms can only be ascertained by examination of series of different ages. On plates 32, 40 and others, such series are figured.

In *T. ogasawarana* at least, the embryonic stage has a triplicate columella. This might be interpreted as a highly accelerated embryo, but in view of the general homology of la-

mellæ in the *Tornatellinidæ*, we look upon the embryo of *Lamellina* as a form retaining ancestral structures, probably common to most or all of the existing genera of the family before their divergence.

Japanese Species.

13. T. OGASAWARANA Pilsbry & Cooke, n. sp. Pl. 32, figs. 1-4, 11, 12.

The shell is imperforate, ovate-pyramidal, brown, not very glossy, weakly marked with growth-striæ. Spire straightly conic, composed of slightly over 5 convex whorls, the last convex below, somewhat compressed laterally in its last half. Aperture oblique, ovate; outer lip thin, but within its edge there is a strong callus rib, slightly brown-tinted, and weaker at the upper curve of the lip. Columella bearing a heavy, white, callous fold, which is produced forward at its lower end, and is either bifid (fig. 4) or nearly simple (figs. 1, 2) within. There is a very deep furrow between the columellar fold and the adjacent basal wall. Parietal lamella usually short, not entering deeply. Length 3.2, diam. 1.7 mm.; length of aperture 1.25 mm.

Bonin Islands (Ogasawara-jima): Minami-jima, types 85760 A. N. S.; also Chichijima, Anijima, Nakano-shima and Imoto-jima (Y. Hirase).

This common species of the Bonin Islands is closely related to *T. subcylindrica* of Guam, in the Marianne group.

Figs. 1, 2, 4 represent adult shells of the type lot from Minami-jima. In a front view the columellar fold appears nearly simple, broad, heavily calloused, and terminating outwardly in a strong lobe, foreshortened in this view, fig. 1, but seen partly in profile in fig. 2. In some examples, otherwise similar, the columellar callous is bilobed as seen in oblique view (fig. 4), by retention of the neanic condition in the ephebic stage. None of these specimens shows pale streaks externally or any other trace of former internal varices. No young specimens were in this lot. Specimens from Nakano-shima, an islet near Muko-jima (or Kater Island), in the Parry group, are exactly similar. Several from Chichi-jima

(Peel Island) are similar, but none are quite adult. The smallest, length 2.5 mm., shows a triplicate columella.

Specimens from Ani-jima (Buckland Island) are a trifle more robust (pl. 32, fig. 3, length 2.9, diam. 1.6 mm.), but perhaps are not absolutely full grown. Four or five whitish varix-streaks are visible through the last whorl. A younger (paraneanic) stage is drawn in figs. 11, 12, representing a shell 2.8 mm. long. The columella is biplicate, a strong horizontally entering lamella being superposed upon the columellar fold. The parietal lamella is very strong, and the palatal rib is crenulate. A second internal palatal rib is visible outside as a whitish streak on the back.

Figures 8, 9, 12, 2 and 1, represent four successive stages of development, the stages shown on plate 32 being as follows:

Figures 1 to 6, ephebic (adult) stage.

Figures 11, 12, paraneanic stage.

Figures 7, 9, 10, metaneanic stage.

Figure 8, last embryonic stage.

It will be noted that some individuals retain the distinctly biplicate columella of the paraneanic stage in the ephebic (fig. 4).

Var. *longa* Pilsbry. Pl. 32, figs. 5 to 10. Differs from *ogasawarana* by its longer spire of fully 6 whorls. Length 3.5, diam. 1.6, aperture 1.2 mm. Chichi-jima (Peel Is.), figs. 5, 6, 8, 9. The specimens are pale-yellowish, possibly fossil. A young one 2.6 mm. long is drawn, fig. 9. An embryonic shell, removed from one of the adults, measures 0.65 mm. long (fig. 8). This has a triplicate columella, as in the neanic stage, but less strongly developed. Figs. 5, 6 are adult individuals.

Living examples of this race, from Imoto-jima, are represented by the adult form, like fig. 5, and the metaneanic stage, shown in figs. 7, 10, length 2.2 mm. The columella is here strongly triplicate. The palatal rib is smooth; within the last whorl there is a second rib on the back, visible as a whitish streak externally.

14. T. BIPLICATA Pilsbry. Pl. 37, fig. 3.

The shell is ovate-pyramidal, thin, fragile, light brownish-

yellow, smooth. Spire straightly conic, the apex rather acute. Whorls 5½, moderately and evenly convex; the last whorl convex throughout, marked with two or three vertical whitish streaks at intervals of one-fourth of a whorl. Aperture ovate, oblique. Outer lip thin and sharp. Columella strongly twisted. An oblique lamella superposed upon the middle of the much more oblique columellar fold, but rather receding, clearly visible in an oblique view in the aperture. Parietal lamella very deeply entering, more than a half-whorl long, flaring outward. A short distance within the thin outer lip there is a narrow but strong white rib, weaker near its upper end, and another is placed about one-fourth of a whorl within. Length 3, diam. 1.7, aperture 1.25 mm.

Japan: Hachijo-jima, Izu (Hirase). Types no 83380 A. N. S. P.

Tornatellina biplicata Pils., Nautilus, xvi, September 8, 1902, p. 57. Referred to by error as "*T. triplicata*" in Proc. A. N. S. Phila., 1905, p. 718.

This species is known to us only in the adult stage, or what we take to be such. It has palatal barriers of the same type as the form *lævis* of *T. serrata* (Pse.), from which *T. biplicata* differs by its less rapidly tapering spire and the much less prominent columellar lamella. *T. biplicata* is more regularly conic than *T. ogasawarana,* and has not the tinted lip-callus of that species.

Hawaiian Species.

15. T. cylindrica Sykes. Pl. 43, figs. 1, 2, 3; pl. 40, figs. 1, 2.

Shell elongate, cylindrical, corneous, perforate; whorls 5-5½, somewhat convex, slightly striate, the last rotund, equal to two-fifths of the whole length, suture impressed; aperture ovate or lunate, a lamella revolving on the parietal wall. Columella thickened, whitish, twisted, sometimes furnished with a small denticle. Length 2.2, breadth hardly 1 mm. (*Sykes*).

Kauai: Makaweli (Perkins); Oahu: Waianae Mts. (type loc.; Perkins, Cooke), under the bark of lehua (*Metrosideros*

polymorpha) trees (Cooke); western ridge of Popouwela (Spalding, Cooke, Pilsbry).

Tornatellina cylindrica Sykes, Fauna Hawaiiensis, Moll., 1901, p. 381, pl. 9, fig. 28.—Ancey, Journ. de Conchyl., li, 1903, p. 301, pl. 12, figs. 11, 12.

None of the specimens of this species seen in the collection of the British Museum nor any of those of the original lot sent to the Bishop Museum are perforate, and it is likely that this term was used in the diagnosis by oversight.

Shells from the "Endodonta locality" on the western ridge of Popouwela, Waianæ Mts., are typical. In the adult stage (pl. 40, fig. 2), the parietal lamella is very strongly developed and fully a half-whorl long. The columella is strongly spiral, terminating in a projecting point as usual. The last whorl, in fully mature shells, is either somewhat flattened or convex peripherally. Length 2.9, diam. 1 mm., aperture 0.9 mm. long; whorls 5½.

In the early metaneanic stage (pl. 40, fig. 1) the parietal lamella is bifid at the edge, the columella is triplicate, median lamella much the largest, and there is a palatal rib. Later stages are like the adult form. These specimens were obtained from leaf siftings.

Specimens from the Waianae mountains (pl. 43, figs. 1, 2, 3) are slightly larger (length 2.6, diam. 1.2 mm.) than Sykes' type. There are slightly over 5 somewhat flattened whorls. The outlines of the spire are almost straight.

An example at the metaneanic stage (fig. 3) is 1.9 mm. in length and has 4½ whorls. The parietal lamella is strongly developed, lobed and with a sinuous margin. The columella is triplicate: the upper fold is quite strong, the median very strong and there is a minute basal nodule. There are two well-developed palatal ribs, one of which, the outer, has three distinct teeth on its margin.

We have not verified the locality Kauai. The species is related to *T. polygnampta*, but its lamellæ are less sinuated in the neanic stage.

15*a*. *T. c. kilohanana* n. subsp. Pl. 40, figs. 3, 6. The shell

is smaller than *T. cylindrica,* length 2.1, diam. 0.9 mm., with 5 whorls; aperture and columella shorter; whorls more convex, with deeper suture. In the neanic stage (fig. 3) the parietal lamella flares outward in a strong lobe, and the columella is triplicate; palatal rib denticulate.

Molokai: Kilohana, near the Leper Settlement trail, on the bark of a small dead tree (Pilsbry & Cooke). Types 108587 A. N. S. P., cotypes no. 33587 B. P. B. Mus. Also Puu Kolekole, on the flat east of the peak (P. & C.).

16. T. POLYGNAMPTA P. & C., n. sp. Pl. 41, figs. 1-5, 7, 8.

The shell is imperforate, elongate, pale-brown, composed of 5½ moderately convex whorls, the last not flattened; lateral outlines nearly straight. Aperture one-third the total length; columella twisted in a stronger spiral than *T. peponum* or *T. oblonga*; parietal lamella strongly flaring outward, high, with uneven edge and fully a half-whorl long. Length 3.3, diam. 1.4, aperture 1.1 mm.

Maui: Makawao and Kaupakalua (Baldwin).

This species is easily distinguished from *T. gracilis* by its thinner shell, the absence of a spiral depression on the last whorl, its broader and larger aperture and by its diameter being greater in proportion to its length. From *T. peponum* it differs by the narrower contour, more strongly spiral columella and larger parietal lamella. In the neanic stage it differs from both species.

A young specimen (pl. 41, figs. 7, 8), at the ananeanic stage, is 2.1 mm. in length and has slightly over 4 whorls. At this stage the columella is triplicate. The columellar fold is well developed, strongly twisted spirally. A very strong horizontal lamella overrides it in the middle, and below this there is a small nodule. The parietal lamella is very high, with sinuous edge. There are two white ribs on the palatal wall, one of them visible in the mouth.

A later stage (metaneanic) is illustrated in figures 4, 5, obliquely basal and front views. The shell is 3.0 mm. long. The columella has lost its lower nodule. The high parietal lamella is bent into one or two conspicuous lobes. The two short palatal ribs are serrate.

At a slightly later stage (paraneanic) the upper columellar fold becomes less prominent and the parietal lamella loses the lobes (fig. 3).

Finally, at the adult or ephebic stage (pl. 1, figs. 1, 2), the median columellar lamella and the palatal ribs disappear entirely.

T. p. kamaloensis P. & C. Pl. 40, figs. 4, 5.

The shell is imperforate, very slender, narrower than *T. polygnampta,* cinnamon; having irregular growth-wrinkles; outlines of the spire nearly straight. Base less convex than in *T. polygnampta.* Whorls 5½, not very convex. Aperture obstructed by a very large, subhorizontal parietal lamella, fully a half-whorl long. Columella more strongly sigmoid than in *polygnampta.* Length 2.9, diam. 1.2 mm.; length of aperture 1.1 mm. The neanic stage (fig. 5) has the parietal lamella more strongly sinuated than *T. polygnampta* from Maui.

Molokai: Western ravines of Kamalo near the old irrigation ditch (Cooke & Pilsbry).

17. T. PEPONUM (Gould). Pl. 35, figs. 1, 2, 5, 6; pl. 42, figs. 4, 5, 6.

The shell is slender, turrite, amber-colored, the surface is smooth, scarcely marked with growth-striæ. Outlines of the spire are straight, the summit obtuse. Whorls 5½, all convex, separated by a well-impressed suture, which has a very narrow transparent margin below. The aperture is somewhat oblique, ovate. Columella vertical, only slightly sinuous, the concavity of its lower part being occupied by a callus. The parietal lamella is fully a half-whorl long, and well developed. Length 3.4, diam. 1.4, length of aperture 1.1 mm.

Hawaiian Islands: "either at Hilo [Hawaii] or on Oahu, abundant on pumpkin vines" (U. S. Expl. Exped.). Hawaii: Olaa, Okala and Kohala (Thaanum). Type no. 5506 U. S. Nat. Mus.

Pupa peponum GLD., Proc. Bost. Soc. N. H., ii, March, 1847, p. 197; Expedition Shells, p. 34; U. S. Expl. Exped., Mollusca and Shells, p. 93, pl. 7, figs. 104, 104*d*.—*Tornatellina*

peponum Gld., Sykes, Fauna Hawaiiensis, Mollusca, p. 382. Not *T. peponum* Ancey, Journ. de Conchyl., li, 1903, pp. 301, 302.

The description and figures 1, 2 are from the type specimen, no. 5506 Smithsonian Institution, already drawn in Gould's figure 104. Mr. Sykes, who has shown that Gould confused three species in his description and figures of *T. peponum*, selected figures 104, 104*d* of the Exploring Expedition Atlas to retain that name; figs. 104 *a*, *b*, *c* becoming *T. confusa* Sykes, while fig. 104*c* is a species of *Tornatellaria*.

A young specimen, pl. 42, figs. 4, 5, is 2.1 mm. long and has 4¼ whorls. At this stage (early metaneanic) the parietal lamella is large, lobed and with a very sinuous margin. There are two strong serrated palatal ribs, only one of which is visible through the aperture. The columella is vertical, slightly sigmoid, the upper columellar fold is not strong; the median lamella is strongly developed and there is no indication of a lower (sub-columellar) tubercle.

A second young specimen (pl. 42, fig. 6, paraneanic stage) is 3.0 mm. long and has 5⅓ whorls. At this stage the parietal lamella is strong, lobed and has a sinuous margin. There are two palatal ribs visible through the aperture. These ribs are not as strong nor are they as serrated as those of the specimen at the metaneanic stage. Neither is the median columellar fold as strong as at an earlier stage.

At the ephebic stage the parietal lamella is straight, the columella twisted and without the median fold, and the palatal ribs have disappeared.

The relationship of *T. peponum* to *T. oblonga* Pse. is extremely intimate. It differs slightly from *oblonga* in having a callus within the lower part of the columellar concavity, visible in an oblique view, and sometimes in the face view. This callus in *T. oblonga* is usually not noticeable, or is less developed. The last whorl of *T. peponum* does not have the flattening and depression characteristic of mature *T. oblonga*. The neanic stage differs.

Pl. 35, figs. 5, 6, are from a specimen measuring length 3.8, diam. 1.5, aperture 1.2 mm., whorls nearly 6, from Maui.

18. T. LANCEOLATA C. & P. Pl. 43, figs. 4, 5, 6.

Shell cylindrical, elongate, light corneous or vitreous, very glossy, thin, transparent, faintly and irregularly marked with minute growth-striæ. Spire with almost lanceolate outlines, summit subacute. Suture impressed, faintly margined below. Whorls 5¾, slightly convex above, becoming flatter, the last cylindrical, with almost straight outlines. There is a broad shallow depression beginning at about the middle of the last whorl and extending to the outer margin of the aperture. Aperture long, narrow, auriform. Parietal lamella large, oblique, slightly arcuate. Columella vertical, strongly twisted. Outer margin of aperture slightly sinuous. Length 3.5, diam. 1.3, length of aperture 1.1 mm.

Oahu: Nuuanu, Tantalus, in very damp localities, under dead leaves and twigs (Cooke).

This species is more closely related to *T. gracilis* than to any other Hawaiian species. The shell is, however, thinner and more transparent; the whorls more loosely coiled; the last whorl is longer in proportion to its breadth and with straighter outlines; the aperture is longer and narrower in proportion to its length; and the spiral depression of the last whorl is not as pronounced as in *T. gracilis*.

An embryonic specimen (fig. 5) from Tantalus is less globular than that of *T. oblonga* and the surface is not as distinctly spirally marked. The parietal lamella is strong, nearly a whole whorl in length. The columella is swollen, with two well-developed oblique folds.

An example (fig. 4) from Tantalus, at the ananeanic stage, is 2.75 mm. in length and has 5⅓ whorls. The parietal lamella is very large, curved, not lobed, with its margin slightly undulating. The columella is triplicate: the upper fold rather strong, the median very strong and the basal nodule fairly well developed. There are two palatal ribs, both of which can be seen in the aperture, the outer low without serrations, the inner strong, with three distinct teeth on its margin. Fig. 6 represents the final (ephebic) stage.

19. T. GRACILIS Pease. Pl. 43, figs. 7, 8, 9; pl. 42, fig. 11.

Shell elongate, slender, thin, glossy, smooth, marked with very delicate growth-striæ, brownish corneous. Whorls 5, convex, the last whorl flattened, sometimes concentrically sulcate in the middle. Aperture small, acutely ovate. Parietal lamella strong, prominent; columella strongly callous, twisted. Length 3.75, diam. 1.5 mm. (*Pse.*).

Kauai (Pease): Kalalau, Limahuli and Wailua (Cooke); Oahu: Diamond Head and Round Top (Cooke); Maui (Thwing; Ancey, for *T. extincta*); Hawaii (Pease, see label Mus. Comp. Zool.); Kona (?Perkins, Thwing). Hamakua (Henshaw). Laysan Island (Bryan).

Tornatellina gracilis PSE., Proc. Zool. Soc. Lond., 1871, p. 460.—? SYKES, Fauna Hawaiiensis, Mollusca, 1900, p. 381.—*Tornatellina extincta* ANCEY, Bull. Soc. Malac. France, vii, 1890, p. 341; Journ. of Malac., xi, 1904, p. 70.—HENSHAW, Journ. of Malac., xi, 1904, p. 64.

Pease's examples of this species, in the Museum of Comparative Zoology, are mixed with typical specimens of *T. oblonga*. None of the specimens of *T. gracilis* in the collection of the Bishop Museum are as broad as Pease's measurements, which were probably taken from one of the specimens of *T. oblonga*.

Specimens from the different Islands measure as follows:

Length 3.0, diam. 1.1; whorls 5¾, Kauai, Kalalau.

Length 3.2, diam. 1.1; whorls 6. Oahu, Diamond Head.

Length 2.75, diam. 1.2; whorls 5¾. Oahu, Round Top (fig. 7).

Length 3.4, diam. 1.2; whorls 6½. Hawaii, Kona (fig. 8).

Embryonic examples (pl. 42, fig. 11) from Round Top, Oahu, have the surface of the shell faintly spirally striate. The columella is slightly swollen; the upper fold is weak, the median strong. The parietal lamella is very strong, about three-fourths of a whorl in length.

An example from Diamond Head (fig. 9), at the metaneanic stage, is 2.14 mm. in length and has 4¾ whorls. The parietal lamella is strong, lobed and with a sinuous margin. The colu-

mella is triplicate, the upper fold moderate, the median very strong, and the lower forming a minute nodule. There are two strong, tridentate palatal ribs visible in the aperture. Part of this armature does not show in the direct front view figured. One of Ancey's types of *T. extincta* (all of which are at the metaneanic stage) is 2.1 mm. long, with 4⅔ whorls. It agrees exactly with young of *gracilis*.

The most distinctive characters of adult specimens of *T. gracilis* are: the cylindrical shell (the last whorl being scarcely broader than the penultimate), the broad shallow depression of the last whorl and the rather small aperture. The examples from Round Top, Oahu, one of which is figured (fig. 7), differ slightly from the shells from the other localities. Adult shells are shorter and broader in proportion to their length and the parietal lamella is not as strongly developed.

Specimens of this species from Laysan Island, collected by Professor Wm. A. Bryan, are scarcely separable from typical Hawaiian material. They differ only in having a slightly smaller shell and in being a shade lighter in color.

The original account of *T. extincta* follows: Shell elongate, oblong, imperforate, corneous, fragile, smooth, glossy. Spire long-conoid, a little obtuse. Whorls 5, convex, regularly increasing, suture minute, margined by transparence; last whorl ovate, convex. Aperture suboblique, armed with a large and strong parietal lamella, an acute, oblique, twisted columellar fold, and a vertical lamina more or less visible in the throat. Length 2.25, diam. 1, alt. aperture .75 mm. Central isthmus of Maui, the types from earth washed out of subfossil specimens of *Amastra extincta* Pfr. (*Ancey*).

"Easy to recognize among Hawaiian forms by the absence of a perforation, its palatal plicæ and the simple columellar fold" (*Ancey*).

20. T. OBLONGA Pease. Pl. 41, figs. 6, 9; pl. 42, figs. 7 to 10.

For description and synonymy of *oblonga* see page 162 under Polynesian species.

Kauai: Lihue, Kipu, Haena, Wainiha and Kilohana

(Cooke); Oahu: Manoa (Baldwin, Cooke), Tantalus, Nuuanu and Makiki (Cooke); Maui: Kapuulena and Kaupakalua (Baldwin); Hawaii: Waipo (Thaanum, Henshaw).

Tornatellina oblonga Pse., Ancey, Mem. Soc. Zool. France, v, 1892, p. 72; Journ. de Conchyl., li, 1903, p. 301.—Henshaw, Journ. de Malac., xi, 1904, pp. 64, 70.

Hawaiian examples differ only in size from specimens collected by Garrett at the Society Islands.

Length 4.2, diam. 1.4 mm. Society Islands.

Length 3.9, diam. 1.4 mm. Kauai (pl. 42, figs. 8, 9).

The Hawaiian examples are found under the same conditions as mentioned by Garrett (Journ. Acad. Nat. Sci. Phila., ix, 1884, p. 81).

In an embryonic specimen (fig. 7), from Nuuanu, Oahu, the shell is imperforate, globose, with very minute raised spiral lines on the upper 1½ whorls. The parietal lamella is rather strong, a little more than a half of a whorl in length. The columella is vertical, with minute twisted folds.

At the beginning of the metaneanic substage (pl. 41, figs. 6, 9; pl. 42, fig. 10), an example, 1.8 mm. in length with 4 whorls, fig. 10, has the following characteristics: the parietal lamella is nearly straight, not lobed, and the margin is very slightly sinuous; the columella is vertical, sigmoid, with a very weak upper fold, the median fold is rather deeply situated, oblique and not very strong and there is a minute lower tubercle; there are two palatal ribs, both of which can be seen through the aperture, their margins are slightly undulate, but not distinctly serrate or toothed as in other species of this section.

Adult shells of *T. peponum* and Hawaiian examples of *T. oblonga* do not differ as much as do the young. In adult specimens of *T. peponum* the whorls are more convex and loosely coiled, the outer margin of the aperture is more convex (in *T. oblonga* it is somewhat flattened), the columella is more strongly twisted and the parietal lamella is stronger and not as straight. The young at the metaneanic and until the paraneanic stage are easily separated by the much stronger median columellar fold, the strongly lobed parietal lamella, and the strongly toothed palatal ribs of *T. peponum*.

T. dentata is the neanic stage of *T. oblonga*, according to the type and a paratype now in the Museum of Comparative Zoology (no. 28918), and which we have examined. The original description follows.

T. dentata Pease. "Shell oblong-ovate, thin, fragile, glossy, smooth, fulvous-corneous. Whorls 4½, convex, suture impressed. Aperture small, acutely oblong-ovate, provided with a strong compressed prominent parietal lamella. Columella strongly callous, twisted, slightly compressed, provided in the middle with a prominent tooth. Length 2.5, diam. 1.25 mm. Hawaii" (*Pse.*).

Tornatellina dentata PEASE, Proc. Zool. Soc. Lond., 1871, p. 460.—PFR., Monogr., viii, p. 317.—? SYKES, Fauna Hawaiiensis, Moll., p. 381.

"The peculiarity of this little species is that the columella, in addition to the usual callosity, which in this species is somewhat compressed, is furnished with a prominent tooth on its middle" (*Pease*).

Species of Polynesia and Micronesia.

20. T. OBLONGA Pease. Pl. 36, figs. 5, 6, 8-11.

Shell long, turrite, thin, the sides straight, apex rather obtuse; brownish-yellow, glossy, very lightly marked with growth-wrinkles. Whorls 6, convex. Aperture very small, oblique, ovate; outer lip simple. Columella lightly thickened, nearly straight and vertical, or only slightly sinuous, in front view, but in profile view it is seen to arch forward at the base (figs. 6, 10). Parietal lamella small, a half-whorl long. Length 3.5, diam. 1.5 mm.; aperture 1.3 mm. (Huaheine).

Society Islands: Huaheine, type loc.; also Tahiti (Garrett), Raiatea and Borabora (Godeffroy Exped.). Marquesas (Garrett, C. D. Voy). Austral Is.: Rurutu. Samoan Is. Fiji Is. (Garrett). Ellice Is.: Funafuti (Hedley). Tonga Is.: Futuna (Dr. Graeffe). Annaa (Pease). Mauiki, Hervey Is. (C. D. Voy). Hawaiian Is.: see p. 160.

Tornatellina oblonga PEASE, Proc. Zool. Soc., 1864, p. 673; Journ. de Conchyl., 1871, p. 93; Proc. Zool. Soc., 1871, p. 473.

—Pfeiffer, Mon. Hel. Viv., vi, p. 264.—Schmeltz, Cat. Mus. Godeff., v, p. 89.—Garrett, Proc. Acad. Nat. Sci. Phila., 1879, p. 21; Journ. Acad. Nat. Sci. Phila., viii, 1881, p. 398; ix, 1884, p. 81; Bull. Soc. Malac. France, iv, 1887, p. 28 (Marquesas); P. Z. S., 1887, p. 187 (Viti Is.); Proc. A. N. S. Phila., 1887, p. 135 (Samoa and Ellice Is.).—Hedley, Australian Museum Memoirs, iii, p. 487 (Funafuti).—W. G. Binney, Ann. N. Y. Acad. Sci., iii, p. 99 (dentition).—Ancey, Journ. de Conchyl., 1903, p. 301 (Maui).—Henshaw, Journal of Malacology, xi, 1904, pp. 64, 70 (Hawaii).—*Tornatellina bacillaris* Mousson, Journ. de Conchyl., 1871, p. 16, pl. iii, fig. 5.—Pfeiffer, Mon. Hel. Viv., viii, p. 316.—Schmeltz, Cat. Mus. Godeff., v, pp. 89, 90.—*Stenogyra* (*Subulina*) *bacillaris* Paetel, Catal., p. 104.—*Tornatellina* "*oblongata* Pease", Pfeiffer-Clessin, Nomenclator Heliceorum Viventium, 1881, p. 342, no. 24 (error for *oblonga*).

The slender shape, small aperture, and nearly straight, vertical columella, which is but slightly thickened, distinguish this species, which according to Garrett, "inhabits all the groups from the Marquesas and Paumotus to the Viti Islands. Like *T. philippii*, it is a ground species, though sometimes found on the fronds of ferns, and ranges from near the seashore to 2,000 or more feet above sea-level. Prof. Mousson gives an accurate description of *oblonga*, under the name of *bacillaris*, from specimens collected by Dr. Graeffe at the Samoa Islands. I collected Mr. Pease's type examples at Huaheine. Its slender form and nearly vertical simple columella will easily distinguish it."

Mr. Pease originally had this form mixed with *T. conica* Mouss., and his description was apparently drawn from both species—perhaps rather more from *conica*. Garrett pointed out the mixture, restricting *oblonga* to the present form. It may be added that specimens in coll. A. N. S. received from Pease are the form herein described as *oblonga*. In the collection of the Academy there are examples from Huaheine (figs. 9-11), Tahiti (figs. 5, 6), Marquesas Is., Rarotonga, Mauiki, Hervey Is., Palmyra I., and the Hawaiian Is. It is very uniform in character, except that the columella varies from

almost straight (fig. 9) to distinctly though slightly sinuous (fig. 5). Rarely one may see one or two low callous streaks within the palatal wall, but they are not at regular intervals. No individuals in the early neanic stage have been examined from Polynesia, so that the presence of well-developed palatal ribs, such as are found in Hawaiian examples, could not be verified. There are none in the middle or late neanic stages.

Specimens of this species taken by the junior author on Palmyra Island are identical with those collected by Garrett on the Society Islands and also with others from the Hawaiian Islands.

We agree with Garrett that *T. bacillaris* Mouss., described from Futuna, Tonga Is., is identical with *T. oblonga,* with which the description agrees in all respects. The original figure of *bacillaris* is copied, pl. 36, fig. 8.

21. T. SERRATA (Pease). Pl. 33, figs. 1 to 6.

"Shell minute, thin, lucid, fragile; conically ovate; whorls five, convex; aperture small, ovate, less than one-half the length of the shell; a spiral lamella on the columellar lip and one at the base; last whorl furnished with three longitudinal lamellæ, extending its whole length and disposed at equal distances from the outer lip, at about one-sixth of the circumference of the whorl apart; edges of the lamellæ serrated" (*Pease*).

Marshall Is.: Ebon Island (Garrett, type loc.). Cook's or Hervey Is.: not uncommon in the lowland forests near the seashore, and ranges throughout the group (Garrett).

Austral Is.: Rurutu (De Gage). Society Is.: Huaheine, Tahiti, etc., adhering to the under side of loose stones, dead wood, among decayed leaves, and sometimes on the leaves of low bushes (Garrett). Kingsmill Is. (Pease collection).

Lamellina serrata PEASE, Proc. Zool. Soc., 1860, p. 439; 1871, p. 473.—*Tornatellina serrata* PFEIFFER, Monogr. Hel. Viv., vi, p. 265.—GARRETT, Proc. A. N. S. Phila., 1879, p. 25 (Rurutu); Journ. A. N. S. Phila., viii, p. 399; Journ. A. N. S. Phila., ix, 1884, p. 82, pl. 2, figs. 22, 22*a*.—*Lamellina lævis*

PEASE, Proc. Zool. Soc., 1864, p. 672; 1871, p. 473.—*Tornatellina lævis* PFEIFFER, Monogr. Hel. Viv., vi, p. 266.

Garrett does not record *serrata* among the snails of the Fiji or Marquesas groups in his catalogues of those faunas. He states that it is "distributed throughout southeastern Polynesia." Such indefinite data are often the record merely of a general impression of the collector, and have but slight scientific value.

T. serrata may be recognized by its conic shape, very convex whorls, strong columellar and parietal lamellæ, and vertical palatal laminæ, which are serrate when fully developed. In *T. subcylindrica* the palatal laminæ and columellar lamellæ are lost in the adult stage, and the shell is more cylindric.

Figures 1 and 2 represent a specimen of the original lot of *serrata*, received from Pease. It is not mature, measuring 2.2 mm. long, 1.3 wide, with 4½ whorls. The columella is nearly straight, solid, without a fold above, but it has a single strong, horizontal median lamella. The parietal lamella appears subtriangular in basal view, as usual in immature specimens. There are two serrate laminæ within the last whorl, one dorsal, the other near the aperture.

Examples from Cook's (Hervey) Is., pl. 33, figs. 4, 5, differ by having an obtuse fold above the subhorizontal columellar lamella, the latter being superposed upon a strongly plicate columella. The adult shells measure, length 3, diam. 1.7 mm. (figs. 4, 5). Young shells down to 2.2 mm. long are similar to fig. 5, except that the upper fold of the columella is a little weaker in some shells.

The Society Island shells (pl. 33, fig. 3) are like those from Cook's Islands, the upper fold of the columella being well developed.

Lamellina lævis Pse. is, as Garrett has stated, merely *serrata* with the palatal laminæ smooth or nearly so. Each lamina passes through a smooth stage before reaching its maximum size, and again in the process of being absorbed. One of the original lot of *lævis* collected in the Society Is. by Garrett, and received from Pease, is figured, pl. 33, fig. 6.

22. T. SUBCYLINDRICA Quadras et Moellendorff. Pl. 33, figs. 10, 11.

Shell not rimate, subcylindric-turrited, delicately striatulate, thin, subpellucid, a little shining, buff-corneous. Spire gradually tapering, the apex rather obtuse. Whorls 6½, rather convex, the last more distinctly plicate-striate, from the beginning rather deeply impressed spirally in the middle. Aperture moderately oblique, rounded-trapezoidal; peristome simple, acute. Columella dilated above, running forward forming a dentiform process, strongly twisted spirally, subdentate above. Parietal lamella oblique, strongly elevated, extending deep within; no palatal plicæ. Length 3.33, diam. 1.5 mm.

In the young the columella is bidentate and the last whorl provided with internal ribs as in the preceding species (*Mlldff.*).

Marianne Is.: Guam (Quadras).

Tornatellina (*Lamellina*) *subcylindrica* Q. et MLLDFF., Nachrichtsblatt d. D. Malak. Ges., vol. 26, Feb., 1894, p. 16.

In the immature stage this snail has serrate palatal barriers, like *T. serrata*, but these are lost in the adult stage, which has also a simply twisted columella. An abundant series shows much variation in the contour of the last whorl, which may be impressed in the middle, as described above, and shown in fig. 10, or merely flattened there. The columella is rather heavily calloused, moderately twisted, and projects forward in a strong, dentiform lobe. This is prominent in a profile view from the left side, though not shown in a front view, the lobe standing then directly towards the observer. An average adult shell measures, length 3.1, diam. 1.3, alt. of aperture 1 mm. (fig. 10). In the adult stage it resembles *T. oblonga*.

The young (metaneanic) shells (pl. 33, fig. 11, 2 mm. long with 4¼ whorls) have convex whorls, the last marked with one or two whitish streaks outside, marking the positions of strong, whitish, vertically placed internal palatal laminæ, serrate at the edge. The columella is tridentate, like that of *T.*

perplexa, the upper and lower denticles small, seen only in an oblique view in the aperture, the median lamella strong and high. The lower or sub-columellar denticle is sufficiently immersed to be invisible in figure 11. The parietal lamella, at this stage of growth, is somewhat triangular, especially as viewed from the base; and its free edge flares outward in the middle.

23. T. MICROSTOMA Quadras et Mlldff. Pl. 33, figs. 8, 12.

Shell subrimate, oblong-conic, thin, subpellucid, delicately striate, slightly shining, buff-corneous. Spire turrited, the sides a little convex, apex acute. Whorls 6½, rather flattened, parted by a slightly impressed suture, slowly increasing, the last spirally impressed, subsulcate before the aperture. Aperture rather oblique, rhombic. Peristome simple, acute, the columellar margin a little dilated, spreading. Columella strongly twisted spirally, lamellarly entering, excised above, projecting in a dentiform process externally. Parietal lamella moderately elevated, produced far within; a single palatal plica remote from the margin. Length 3.5, diam. 1.75 mm.

In the young shell the columella is trilamellate, the parietal lamella more elevated, last whorl having three internal transverse denticulate ribs, which wholly disappear in adults (*Mlldff.*).

Marianne Is.: Guam (Quadras).

Tornatellina (*Lamellina*) *microstoma* Q. et MLLDFF., Nachrichtsblatt d. Deutschen Malak. Gesellschaft, vol. 26, Feb., 1894, p. 16.

This species is much more robust than *T. subcylindrica*. It resembles *T. nitida* Pse. in shape. The adult form is hardly distinguishable from *T. moellendorffiana*, but when the two are laid side by side, it is seen that *microstoma* has a just perceptibly narrower spire, and the whorls are less convex. In an oblique view in the mouth one can see a small rather sharp columellar fold close to the insertion and rather deep within in *microstoma*, while *moellendorffiana* has a heavier, callous fold.

In the young stage, *microstoma* is very distinct by its lamellæ and plicæ. In a specimen 2.8 mm. long, 4¾ whorls (pl. 33, fig. 8), the columella has a strong, subhorizontal central lamella, a smaller, more delicate lamella above, and a minute, very deeply immersed one below. In the palatal wall there is a strong, serrate barrier, with another more deeply placed, visible as a whitish streak outside. The parietal lamella flares outward in the middle. Younger examples, down to 2 mm. long, have the same armature.

The figures are from specimens from the Quadras collection.

24. T. MOELLENDORFFIANA Pilsbry, n. sp. Pl. 38, figs. 7, 10, 11.

The shell is imperforate, oblong-conic, brownish-corneous, shining, very distinctly marked with growth-striæ. The spire has slightly convex outlines and an obtuse apex. Whorls 5½, moderately convex, separated by a delicately margined suture; the last whorl flattened in the middle, its last half rather deeply impressed there; base very convex, sack-like, impressed around the axis. The aperture is quite oblique, ovate. Columella short and vertical, heavily calloused, the callus, in oblique view, is seen to emerge in an oblique, rounded fold or plait, which projects forward in a short lobe, somewhat tooth-like, at its outer end. Some distance within the basal lip there is a low callous ledge, given off from the columella; it is more or less distinct within the outer lip also, as far up as the median contraction, where there is usually a more or less distinct callosity. The well-developed parietal lamella enters deeply. Length 3.7, diam. 1.8, length of aperture 1.2 mm.

The immature stage (pl. 38, figs. 7, 10, 2.8 mm. long, with nearly 5 whorls) has the aperture like the adult, except that the callus within the outer and basal lips is stronger.

Marianne Is.: Guam (Quadras), associated with *T. microstoma.*

The adult stage of this species resembles that of *T. microstoma* Mlldff., but it is slightly more robust with more convex whorls. The immature shells (figs. 7, 10) however differ

widely, the present species having no distinct columellar lamellæ and no palatal serrate plate, though there is a low palatal callus. It is not a typical *Lamellina*, but the palatal callosity removes it from *Tornatellinops*.

The basal callus passes out from behind the columellar callus in a rather peculiar way in this species and *T. microstoma*.

Section TORNATELLINOPS, n. sect.

Lamellidea PILS., 1910, definition, but not the type assigned.

Tornatellinæ with the columella twisted and somewhat calloused, forming an oblique fold above, but not bearing a columellar lamella at any stage of growth; there are no ribs, plicæ or denticles within the outer lip at any stage. Shell imperforate, oblong-conic, composed of 5 to 6 whorls. Type *T. novoseelandica*.

Some species of *Lamellina*, in the adult stage, are indistinguishable from this group, but their young stages differ. Most of the species now placed in *Tornatellinops* are known only by the adult stage, and their systematic place is therefore more or less uncertain. Some of them are likely to turn out to belong to other sections, when series of the young are examined. *Elasmatina* differs from this group by its long contour and numerous whorls.

This group, under the name *Lamellidea*, was properly *defined* in the synopsis published by the senior author in 1910; but unfortunately the species then selected as type does not agree with the definition, proving to have palatal ribs in the neanic stage.

25. T. MONODONTA Pilsbry & Hirase. Pl. 37, figs. 1, 2.

Shell imperforate, ovate-conic, thin, pale yellowish-corneous, imperfectly transparent, almost smooth. Spire straightly conic, the apex obtuse. Whorls 4¾, moderately convex, the last somewhat swollen. Aperture oblique, ovate, somewhat less than half the total length. Outer lip thin and simple, columella strongly twisted, forming a white spiral fold. *No parietal lamella*. Length 3.25, diam. 1.9 mm.

Bonin Islands: Imoto-jima (type loc.), and Haha-jima, Ogasawara. Types no. 86479 A. N. S. P.

Tornatellina monodonta Pilsbry and Hirase, Nautilus, xviii, May, 1904, p. 6.

This form is distinguished at once from others described from Ogasawara-jima and the islands of Izu by the absence of a parietal lamella. *T. rucuana* is not so smooth, and has a low parietal lamella.

The columellar fold is distinctly if rather minutely doubled (fig. 2), especially in immature specimens, though some trace of the same structure may be seen in adults. Fig. 1 represents the type. Fig. 2 is a specimen from Haha-jima, viewed obliquely from below.

26. T. RUCUANA Pilsbry & Hirase. Pl. 37, figs. 4, 5.

The shell is imperforate, oblong-conic, thin, brownish-corneous, the early whorls brown; smoothish, weakly marked with growth-lines, somewhat glossy. Spire conic, the apex obtuse. Whorls 4½, convex. Aperture oblique, ovate; outer lip thin and simple. Columella rather strongly twisted spirally, in immature specimens indistinctly doubled (fig. 5), a low fold appearing about the middle and very obliquely running downward. In adult shells this is not noticeable. Parietal lamella small and low, about a half-whorl long. Length 3.3, diam. 1.9, length of aperture 1.4 mm.

Loochoo (Ryukyu) Islands: Kerama-jima (Hirase). Type no. 89891 A. N. S. P.

Tornatellina rucuana P. & H., Proc. A. N. S. Phila., lvii, p. 718 (Dec. 8, 1905).

This species resembles *T. monodonta*, from which it differs chiefly by the possession of a low but well-developed parietal lamella. It is also less conic, a little more oval in shape. Half-grown examples are like the adult stage in this respect. The parietal lamella is smaller than in *T. ogasawarana* or *T. nakadai*.

27. T. NAKADAI P. & C., n. sp. Pl. 37, figs. 8, 9, 10.

The shell is slender, pale brownish-yellow, nearly smooth,

marked with faint growth-lines. Whorls 6, moderately convex. Aperture small, ovate, about one-third the length of the shell. Columella rather strongly twisted. Parietal lamella strong.

Length 3.3, diam. 1.35, aperture 1 mm.

Length 3, diam. 1.45, aperture 1 mm.

Bonin Islands (Ogasawara-jima): Chichi-jima (Hirase). Type no. 83007 A. N. S. P.

This snail is very closely related to *T. peponum* (Gld.), but it differs by the *more strongly twisted columella*, drawn in fig. 9, for comparison with that of *peponum*, pl. 35, fig. 2. As in *T. peponum*, there is, at the base of the columellar fold, a callus, or as it might be termed, a small subcolumellar fold, rather deeply placed, and filling the concavity of the lower part of the columella.

T. nakadai differs notably from other known forms of the Japanese islands by its more slender contour, resembling *T. peponum*, *T. oblonga*, and *T. subcylindrica*. Only the adult stage is known, and it is placed in *Tornatellinops* provisionally, pending an examination of the neanic stage. It is named in honor of Mr. Nakada, whose researches on behalf of Mr. Hirase have added many species to our knowledge of the Bonin Island fauna.

28. T. HATAIANA P. & C., n. sp. Pl. 37, figs. 6, 7.

The shell is imperforate, ovate, cinnamon-colored, somewhat transparent, smooth and glossy. Whorls 3½, not very convex, aperture about half the total length; parietal lamella low, about one-third of a whorl long. Columella convex in front view, seen to be minutely biplicate when viewed obliquely from below. Length 2.2, diam. 1.4, aperture 1.1 mm.

Japan: Kita-Iwo-jima, Izu, one of the Sulphur Islands. Type no. 84966 A. N. S. P. (part of 1093 coll. Hirase).

The apex is less slender than in *T. biplicata*. The specimens are probably not fully adult. In a paraneanic example, fig. 7, the columella is more distinctly biplicate, and there are no palatal ribs or plicæ.

29. T. PONAPENSIS P. & C., n. n.

Shell imperforate, elongate, ovate-conic, thin, pellucid, delicately striatulate, a little shining, pale buff-corneous. Spire rather high, the apex a little obtuse. Whorls 4¾, a little convex, the last as long as the spire. Aperture rather oblique, narrowly oval; peristome simple, acute. Parietal lamella rather strong, high, spirally entering a long distance. Columella subtruncate, strongly twisted, provided with a low, spirally receding lamella. Alt. 2.5, diam. 1.5 mm. (*Mlldff.*).

Caroline Is.: Ponape (Etscheid).

Tornatellina pusilla MLLDFF., Journal of Malaeology, vii, March 24, 1900, p. 114. Not *T. pusilla* Gould.

An unfigured species of uncertain relationships, perhaps belonging near *T. nitida.*

30. T. GAYI C. & P., n. sp. Pl. 42, fig. 3.

The shell is narrowly ovate, brownish-corneous, very thin, fragile, transparent, nearly smooth, minutely marked with growth-striæ. Outlines of the spire narrowly ovate, summit smooth, somewhat obtuse. Suture well impressed, faintly margined. Whorls nearly 4½, somewhat convex, the last ovate, tapering towards the base. Aperture subauriform. Parietal lamella minute. Columella nearly straight, slightly sigmoid, without a superposed median lamella. Outer margin of aperture thin, arcuate. Length 1.9, diam. 1.0, length of aperture 0.7 mm.

Kauai: Makaweli, under dead leaves (Cooke).

Only three specimens of this species were taken, all of which are adult. It is the smallest species of the genus so far reported from the Hawaiian Is. *T. gayi* seems to be related to *T. cylindrica*; it is smaller, the outlines of the spire are more convex, and the parietal lamella is much less developed. The species is, for the present, located in section *Tornatellinops*, but this position is provisional, pending the discovery of young shells.

31. T. TANTALUS P. & C., n. sp. Pl. 40, figs. 8, 9, 10.

The shell is oblong, slender, cinnamon, distinctly but ir-

regularly striate; outlines of spire slightly convex; last whorl somewhat compressed laterally. Parietal lamella very broad, subhorizontal, about a half-whorl long. Columella spirally twisted.

Length 3, diam. 1.2, aperture 1 mm.; 5 whorls.

Length 2.4, diam. 0.9, aperture 0.8 mm.; 4⅔ whorls.

In the neanic stage (fig. 8, length 1.8 mm.) the parietal lamella is broader but not sinuated; the columella has a stout median lamella; there are no palatal ribs or plicæ.

Oahu: southwestern rim of Tantalus bowl, outside, living in lichen growing on damp tree trunks (Cooke & Pilsbry).

With some resemblance to *T. cylindrica*, this species differs by the characters of the neanic stage and the stronger striation. The systematic position of the species is uncertain, as it may prove to have *Lamellina* characters in the ananeanic stage, which is not represented in the numerous series under examination.

32. T. IMPRESSA Mousson. Pl. 34, fig. 8.

"Last whorl somewhat tapering, the side concavely impressed in the middle. The last whorl tapers as it nears the aperture, and becomes a little concave, the concavity spiral in direction. At the same time it thickens a little, as may be seen by the greater opacity. Between this form and the type with rounded last whorl there are all possible intermediate forms" (*Mouss.*).

Kanathia, Fiji Is. (Dr. Graeffe). Mousson reports *T. conica* var. *impressa* as occurring also in Vai-Tupu, Ellice Is., and as an individual variation on other islands of the group.

Part of Garrett's specimens of *T. conica* from Huaheine are referable to var. *impressa*. Pl. 34, fig. 8, represents one from Huaheine measuring 3.5 mm. long, diam. 1.55, aperture 1.1 mm.; nearly 6 whorls.

T. pusilla Gld. has a similar impressed zone on the last whorl, but it differs by having a more heavily calloused columella; that of *T. impressa* is only moderately thickened above, where the columellar curvature is greatest. "Var. *impressa*"

is, we believe, a variation occurring in *conica* colonies, not a distinct race. The peripheral impression is rather an old-age character in this family. As the name *conica* is preoccupied in *Tornatellina*, the present species may be called *T. impressa*, and the typical form of *conica* Mouss. may be known as *T. impressa* var. *normalis* P. & C., n. n. The original account of *T. conica* follows.

T. conica Mousson (pl. 34, figs. 5, 6). Shell imperforate, elongate-conic, pellucid, slightly striatulate, glossy, corneous. Spire regular, conic, the apex rather acute; suture simple, impressed. Whorls 5 to 5½, rather convex, the last not descending, rather swollen above, rounded, less so in the middle. Aperture a little oblique (25 degrees with the axis), two-sevenths the total length, oval, provided with an acute, entering, median parietal lamella. Peristome unexpanded, subacute, the margins not approaching, right margin curved more above and below than in the middle, basal regularly curved, columellar margin expanded and adnate above. Columella formed of a narrow, subvertical, twisted thread, which passes into the basal margin. Length 2.9, diam. 1.5 mm. (*Mouss.*).

Samoan Is.: Upolu; Tutuila, common under dead leaves, chiefly of palms (Dr. E. Graeffe, type loc.). Fiji Is.: Kanathia and Vanua-Balavo, Lomma-lomma (Graeffe). Tonga Is.: Lifuku, island of Hapai (Graeffe). Hervey and Austral Is. Ellice Is.: Funafuti, Vai-Tupu, Niutao, Nui, Nukufetau (Dr. Graeffe). Society Is.: Huaheine. Marquesas (Garrett).

Tornatellina conica, Mousson, Journ. de Conchyl., 1869, p. 342, pl. 14, fig. 8; 1870, p. 128 (Viti Is.), with var. *impressa*, 1871, p. 16 (Tonga Is.); 1873, p. 106 (Ellice Is.). Pease, Proc. Zool. Soc., 1871, p. 473. Pfeiffer, Mon. Hel., viii, p. 316. Garrett, Proc. Acad. Nat. Sci. Phila., 1879, p. 21 (Rurutu); 1887, p. 136 (Samoan Is.); Journ. Acad. Nat. Sci. Phila., 1881, p. 399 (Hervey Is.); ix, 1884, p. 81 (Society Is.); Bull. Soc. Malac. France, iv, 1887, p. 29 (Marquesas); P. Z. S., 1887, p. 187 (Viti Is.). Schmeltz, Cat. Mus. Godeff., v, p. 89.

In the shape of the shell and strongly convex whorls, this

species resembles *T. serrata*. Mousson's description is given above and his figure copied, pl. 34, fig. 5. Garrett writes as follows: "Not uncommon, and ranges from the Paumotu to the Viti Isles. I forwarded Mr. Pease a number of examples of this species intermixed with *oblonga*, and supposing the two to be identical, he included it in his diagnosis of the latter species. Having collected hundreds of specimens of both species at the different groups, I do not hesitate to consider them quite distinct. As compared to *oblonga*, it is lighter-colored, more robust, spire more rapidly tapering, body-whorl larger and more or less compressed in the middle. The parietal lamina is larger, and the columella more tortuous."

We have figured also an example from Huaheine, collected by Garrett (pl. 34, fig. 6). It measures, length 3, diam. 1.55, aperture 1 mm., whorls 5½.

Two species of *Tornatellina*, *T. oblonga* Pse. and *T. impressa normalis* (*T. conica* Mouss.), were collected by the junior author on Palmyra Island in July, 1913. Both were very common on the fronds of the birdnest fern (*Asplenium nidus*), leaves of Pandanus, the trunks of trees and fallen leaves of the coconut palm. Undoubtedly both species were introduced at the time when coconuts were brought in large numbers for planting.

Palmyra specimens of *impressa normalis* have a slightly stronger parietal lamella and the apical whorls are not as tightly coiled as specimens from the Society Islands, collected and identified by Garrett.

The systematic place of *T. impressa* is uncertain. It may be a *Lamellina*; but as yet series of the young have not been examined.

Var. *intuscostata* P. & C. Pl. 34, fig. 7.

The shell is conic, with straight general outlines, corneous-brown, marked with opaque whitish longitudinal streaks, of which there are 2 or 3 on the last whorl, usually one on the penultimate whorl; these streaks being caused by internal white ribs. Whorls 5¼, rather strongly convex, the last one inflated. Aperture quite oblique, ovate. Parietal lamella small, deeply entering. Columella somewhat calloused,

weakly twisted, moderately folded above, projecting forward in the middle. Palatal laminæ smooth, rather low, chiefly placed with the first half of the last whorl. Length 3.2, diam. 1.7, length of aperture 1.2 mm.

Society Is.: Huaheine (A. J. Garrett), with *T. conica*.

Several examples differ from *T. conica*, with which they were found, in having internal callous ribs at intervals, as in *Lamellina*, but the columella is not lamellate, being merely twisted, as in *T. conica*, at least in the mature stage, thereby differing markedly from the typical Lamellinæ. Further material, especially young shells, are needed to determine the status of this form.

33. T. PUSILLA (Gould). Pl. 34, figs. 1 to 4.

Shell small, elongate, conic, polished, whitish-corneous, perforate. Spire acute. Whorls 6, convex, tabulate above. Aperture subquadrate, posteriorly furnished with a lamella revolving inward. Peristome reflexed, the right margin sinuous. Length three-twentieths, width three-fortieths inch. [L. 3.75, diam. 1.87 mm.] (*Gould.*)

Paumotu Is.: Metia (Makatea), an island in the western end of the archipelago, found under stones (Couthouy, U. S. Expl. Exped.).

Partula pusilla GOULD, Proc. Boston Soc. N. H., ii, 1847, p. 197; Expedition Shells, p. 33; U. S. Expl. Exped., Mollusca and Shells, p. 83, pl. 7, f. 90, 90*a*. *Cf.* Ancey, Bull. Soc. Malac. France, vi, 220.

Gould's description and figure (fig. 4) are copied.

In describing the peristome as "reflexed" he evidently referred to its columellar margin only. This species resembles *T. impressa* in all but the perforation; and it may be suspected that Gould was mistaken about this point. Unfortunately, the type specimen is no longer to be found in the National Museum.

Shells (pl. 34, figs. 1, 2, 3) agreeing well with the figure and dimensions of *pusilla* are before us from Rarotonga, and another lot was labeled "*T. nitida*, Ebon Island." The shell is imperforate, turrite, with slightly convex sides, compara-

tively solid, corneous-brown, distinctly marked with growth-wrinkles. Whorls 5½, strongly convex, but the last has a wide contraction or impressed zone around the middle. The base is very convex. The aperture is small, very oblique; outer lip thin and simple. Columella is vertical, *heavily calloused above the middle,* the callus sometimes *very indistinctly* biplicate by reason of a slight median impression. A deep groove runs above the callus around the insertion of the columella. The parietal lamella is strong and high, running inward a half-whorl. Length 4.2, diam. 2 mm.; length of aperture 1.5 mm. (figs. 1, 2).

The shells from Rarotonga are a little smaller, length 3.6, diam. 1.8, aperture 1.25 mm., but they agree in the heavy columellar callus and other characters (fig. 3).

T. pusilla is a larger, more solid, more robust shell than *T. i. normalis.* Specimens from Huaheine which we have referred to *T. impressa* Mouss., resemble *T. pusilla* rather closely, but they have not so heavily calloused a columella, and are smaller.

34. T. AFFINIS Garrett.

"Shell small, imperforate, ovate-conic, thin, smooth, shining, transparent, light brownish-horn color; spire oblong-conic, with planulate outlines; apex obtusely rounded; suture narrowly margined, whorls six, plano-convex, slowly and regularly increasing, the last not deflected in front, rather large; aperture oblique, irregularly abbreviate-ovate, a little more than a third the length of the shell; parietal wall with a strongly compressed prominent lamina; peristome acute, straight, regularly curved, margins remote; columella tortuous, not plicate or dentate. Length 2¾, major diameter 1½ mm. (*Garrett*).

Austral Is.: Rurutu (Ch. De Gage).

Tornatellina affinis GARRETT, Proc. Acad. Nat. Sci. Phila., March 25, 1879, p. 23.

"This species, which we have ventured to record as new, is shaped very much like *philippii,* but the whorls of the spire are flattened, and the body is not so turgid as in that species.

The columella has the peculiar twist of *conica*, but our shell is smoother, more shining, the spire more tapering, and the whorls much more depressed" (*Garrett*).

35. T. TROCHLEARIS 'Beck' Pfr. Pl. 35, fig. 9.

Shell ventricose-fusiform, glossy, pellucid, pale corneous. Whorls 6, flattened, the last shorter than the spire, tapering basally. Aperture oblong; peristome simple, lamella of the parietal wall of the aperture transverse, large, acute. Length 4, diam. 2 mm. (*Pfr.*).

Rapa (Opara) Island (Anton coll.); Masafuera (Beck).

Tornatellina trochlearis BECK, Index Moll., 1837, p. 80 (nude name), *teste* Anton.—PFR., Symbolæ, ii, p. 55; Monogr., ii, 393; iii, 527; iv, 652; vi, 265.—KUESTER, Conchyl. Cab., p. 151, pl. 18, f. 18, 19.—*Strobilus pellucidus* Mühlf., ANTON, Verzeichniss, etc., p. 46, no. 1693 (nude name).

The figure is from Kuester. Dohrn has suggested that the species belongs to the Auriculacea. It is not likely that it inhabits both of the islands mentioned above.

36. T. PHILIPPII Pfeiffer. Pl. 36, fig. 4.

Shell oblong-conic, thin, striatulate, pellucid, glossy, brownish-corneous. Spire conic, acute, whorls 6, convex, the last subglobose, about one-third the total length. Aperture ear-shaped, contracted by a compressed, entering parietal lamella and a twisted, subtruncate columellar callus. Length 3.5, diam. 2 mm.; aperture 1.25 mm. long (*Pfr.*).

Society Islands: Tahiti (Philippi, Jr.); distributed throughout the group, but not plentiful. They were found adhering to the under side of loose stones, beneath dead wood and decaying leaves (Garrett). Cook's or Hervey Is.: Aitutaka, under decaying leaves in forests near the sea-shore. Austral Is.: Rurutu. Marquesas Is.: Dominique Island, under dead leaves (Garrett).

Tornatellina philippii Pfeiffer, Zeitsch. Malak., 1849, p. 93; Mon. Hel. Viv., iii, p. 524; Conchyl. Cab., *Pupa*, p. 152, pl. 18, f. 20, 21.—PEASE, Proc. Zool. Soc., 1871, p. 473—GARRETT, Proc. Acad. Nat. Sci. Phila., 1879, p. 22; Journ. Acad. Nat.

Sci. Phila., 1881, p. 397; 1884, ix, p. 81; Bull. Soc. Malac. France, iv, 1887, p. 28. — *Leptinaria philippii* H. and A. Adams, Gen. Moll., p. 141.

"It may be readily known by its swollen whorls, turgid body, large, compressed, parietal laminæ, and somewhat tortuous columella" (Garrett). We have not recognized this shell in material examined. The figure is from Kuester.

37. T. VOYANA P. & C., n. sp. Pl. 35, figs. 12, 13.

The shell is imperforate, oblong-conic, sayal brown, glossy, minutely and irregularly striate. Whorls 5½, moderately convex, the last slightly flattened peripherally. Aperture ovate. Parietal lamella well developed, nearly a half-whorl long. Columella but little curved, projecting in a point at the columellar edge, as usual. Length 3, diam. 1.5 mm.

Hervey Group: Mauiki (C. D. Voy). Types no. 83154 A. N. S. P. Society Is.: Huaheine (A. Garrett).

Several immature (paraneanic) specimens are like the adult stage in structure of the columella. In one specimen of the type lot, fig. 13, there are two low, oblong, internal palatal denticles; one, with the long axis vertical, stands a short distance within the outer lip, the other, on the same level, a half-whorl in, has the long axis in a spiral direction. The shell is not otherwise different from the rest of the lot. This may indicate that the species is a degenerate member of the *T. nitida* group.

We have not been able to compare *T. philippii* or *T. trochlearis*. The far less convex whorls separate *T. voyana* from *T. conica* Mouss.

3. *Species of New Zealand, Lord Howe Island, Australia, New Guinea, New Caledonia and Melanesia.*

These forms resemble *T. oblonga* and its allies in contour. There is a long parietal lamella, a rather strongly sigmoid columella, and no ribs or plicæ within the outer wall, at least in the adult stage. We know nothing of the Tornatellinæ of the Melanesian archipelagos, yet the genus is almost certain to occur in New Ireland, the Solomons, New Hebrides, etc. The species of the Kermadecs have a Polynesian aspect.

38. T. IREDALEI P. & C., n. sp. Pl. 39, figs. 6, 7, 8.

The shell is imperforate, oblong-conic, the diameter about half the length, cinnamon-brown, slightly transparent. Outlines of the spire straight. Whorls 5½, moderately convex. Parietal lamella not large, nearly a half-whorl long. Columella weakly sigmoid, the columellar margin slightly convex but not angular in profile view. Length 2.9, diam. 1.5, aperture 1.1 mm.

Kermadec Is.: Sunday Island (Tom Iredale). Type to be deposited in the Canterbury Museum, N. Z.; paratype in coll. A. N. S. P.

The columella is distinctly less sinuous than in *T. novoseelandica*. *T. petterdi*, *mastersi* and *noumeensis* are decidedly stouter in figure.

The paraneanic stage, 2.4 to 2.5 mm. long, is like the adult in apertural characters. No younger examples were in the lot submitted by Mr. Iredale, after whom the species is named.

This may be the species which has been recorded as *T. novoseelandica* from the Kermadecs. See Iredale, Proc. Malac. Soc. London, x, 1913, pp. 364, 365.

39. T. RAOULENSIS P. & C., n. sp. Pl. 39, figs. 9, 10. 11.

The shell is imperforate, oblong-conic, the diameter slightly more than half the length, buffy-olive, nearly smooth. Whorls 6, rather strongly convex, united by a rather deep suture, which appears nearly horizontal. Aperture more than one-third the length of shell. Parietal lamella very oblique, rather high but short, about one-third of a whorl long. Columella having a low, wide, spiral prominence in the middle, terminating in a strong, projecting angle, prominently seen in a profile view (fig. 9). Length 3.3, diam. 1.7, aperture 1.3 mm.

Kermadec Is.: Sunday (Raoul) Island (Tom Iredale). Type to be deposited in the Canterbury Museum, N. Z.; paratype in coll. A. N. S. P.

This is a larger, more robust species than *T. iredalei*, with the parietal lamella more oblique, shorter, and the columellar fold ending in a projecting point, as in *Lamellina* and the

T. perplexa group. A paraneanic shell is like the adult except for its more fragile lip. No young specimens were sent; so that its sectional position is not free from doubt. It differs obviously from all species found in Australia, New Zealand and New Caledonia.

40. T. NOVOSEELANDICA Pfeiffer. Pl. 38, figs. 1, 2.

Shell oblong-turrite, thin, smooth, glossy, fulvous-corneous. Spire turrite, rather acute. Whorls 5, a little convex, the last nearly one-third the total length, rounded at base. Parietal lamella deep, of moderate size. Columella white-calloused, highly twisted-subtruncate. Aperture slightly oblique, subauriform. Peristome thin, acute. Length 3.5, diam. 1.5, aperture 1.33 mm. long (*Pfr.*).

New Zealand (Strange): North Island at Whangarei Heads (C. Cooper), near Auckland (Major Greenwood), Thames (Adams). Hunua Range (Brown) and Waimarama; very often found on fronds of *Hymenophyllum* (Suter).

Tornatellina novoseelandica PFR., P. Z. S., 1852, p. 149 (June 27, 1854); Monographia Hel. Viv., iii, 524 (1853); iv, 651; vi, 263.—KUESTER, Conchyl. Cab., *Pupa*, p. 149, pl. 18, f. 10, 11.—HEDLEY & SUTER, Proc. Linn. Soc. N. S. Wales (2), vii, 1892, p. 660.—SUTER, Journ. de Conchyl., xli, 1893, p. 236; Manual of the N. Z. Moll., p. 769.—*Tornatellina neozelanica* Pfr., HUTTON, Trans. New Zealand Institute, xvi, 191. —*Elasmatina reclusiana* GRAY, P. Z. S., 1849, p. 167 (Auckland), not of Petit.

A minute, slender, imperforate species, having the columellar fold unusually strong, and the whorls of the spire quite convex, the last whorl much less so. The parietal lamella runs deeply into the aperture. Fig. 2 is a copy of Kuester's illustration of Pfeiffer's type. Fig. 1 was drawn from a specimen received from Mr. Suter, length 3 mm. (The size-mark on the plate is too long.)

41. T. JACKSONENSIS (Cox). Pl. 38, figs. 5, 6.

"Shell subperforate, oblong-turreted, very thin, translucent, rather shining, smooth, under the lens showing faint

longitudinal striæ. Yellowish-horny. Spire elongated, gradually tapering, rather blunt at the apex. Whorls 5 to 6, slightly convex, last equaling one-third of the length. Aperture irregularly ovate, with a thin central, vertical, parietal plate. Columella twisted, its edges entering spirally inwards, leaving above it a deep entering groove or channel; peristome simple, acute. Length 0.14; breadth 0.06 inch; aperture 0.05 inch long'' (*Cox*).

Australia: Darling Point and other places about Port Jackson; Wollongong, etc. (MacGillivray); Botanic Gardens, Sydney, N. S. Wales (Brazier).

Bulimus jacksonensis Cox, Catalogue of Australian Land Shells, 1864, p. 25; Ann. and Mag. N. H. (3), xiv, p. 185.—Pfr., Monogr., vi, 149.—*Achatinella j.* Cox, Monograph of Australian Land Shells, p. 77, pl. 12, f. 15.—*Tornatellina jacksonensis* Brazier, P. Z. S., 1872, p. 807.—Pease, Journ. de Conchyl., xvii, 1869, p. 176.

A series of specimens from Port Jackson, no. 28920 Mus. Comp. Zool., does not show any marked difference from *T. novoseelandica*, unless it be that the whorls are not quite so convex. As Australasian conchologists, having abundant material for comparison, have not united the two, we leave both standing as species, although we doubt whether they are separable. Two specimens, the larger measuring 3.8 x 1.6 mm., with 5¾ whorls, are drawn in pl. 53, figs. 12, 13. Figures 5, 6 of plate 38 are copied from Cox.

42. T. mastersi Brazier. Pl. 38, fig. 8; pl. 53, fig. 11.

''Shell imperforate, somewhat ovate, very thin, transparent, slightly shining, horny-green, faintly and transversely striated. Whorls 5, convex, the last large and inflated, equaling half the length; suture impressed; spire conoid; apex obtuse; base rounded. Aperture vertical, ovate, peristome thin, simple; long, narrow, minute-like callous tooth on the center of the body-whorl; whitish, margins regularly arched, the columellar margin white, thickened with callus, twisted, divided in the middle and entering spirally inwards, leaving a deep groove; above reflected at its outer edge. Length 1¼, breadth ¾ line'' (*Brazier*).

Darnley Island, Torres Straits (Chevert Exped.). Also northeastern Queensland and islands between there and New Guinea.

Tornatellina mastersi Braz., Proc. Linn. Soc. N. S. Wales, i, 1876, p. 108.—Hedley, P. L. S. N. S. W., xxvi, 1901, p. 705, pl. 34, f. 13, 14.

"This species is of a very dull color, more so than any of the other species described in this paper. Eighteen specimens found on a tree at 600 feet elevation, the highest part of the island" (*Brazier*).

Mr. Charles Hedley, whose figure of the type is copied on plate 38, writes as follows:

"One of the types from Darnley Island, 2.9 mm. in length, is shown at fig. 14 [8]. An example of *T. petterdi* Brazier (*op. cit.*, p. 109) from no. iii, Barnard Islands, 2.7 mm. long, is represented by fig. 13 [pl. 38, fig. 9]. It seems to me an immature state of the same species. *T. grenvillei* Brazier (*op. cit.*, p. 109) appears from a study of the types also to be identical with *T. mastersi*. To this species belongs also a *Tornatellina* from Boyne Island and Warroo, Queensland, identified as *T. eucharis* by Hedley and Musson these Proceedings [Linnean Society of N. S. Wales] (2), vi, 1892, p. 558, pl. 28.

"The double twist on the columella distinguishes this from the very similar *T. oblonga* Pease, of the Central Pacific. *T. jacksonensis* Cox, is a more slender shell" (*Hedley*).

In a series from Somerset, Cape York, the largest shell measures 3.6 x 1.9 mm., with 5¼ whorls (pl. 53, fig. 11). Others are smaller, and resemble Mr. Hedley's figures in contour. The columella has two small and very oblique folds, which in the young are hardly noticeable in a front view. Parietal lamella about one-third of a whorl long, very low and slender. It is smaller in the neanic stage than in the adult.

The original descriptions of the forms regarded as synonyms here follow.

T. petterdi Brazier. Pl. 38, fig. 9. "Shell imperforate, oblong-turrited, very thin, transparent, shining, smooth, light yellowish-horny. Whorls 5, convex, last equaling half the

length; spire moderately elongated, obtuse at the apex. Aperture nearly vertical, ovate; small thin tooth placed in the center of the body-whorl; columella thickened, twisted, the edge entering spirally inwards, leaving a deep groove above; peristome thin, simple. Length 1½, breadth 1 line'' (*Brazier*).

Darnley Island, Torres Straits; found on trees (Chevert Exped.).

Tornatellina petterdi Brazier, Proc. Linn. Soc. N. S. Wales, i, 1876, p. 109.

T. grenvillei Brazier. ''Shell imperforate, oblong, thin, glossy, transparent, light horn-color, obliquely striated, decussated with minute silky lines. Whorls 5, roundly convex; suture distinctly impressed; spire conoid; apex obtuse; base convex. Aperture somewhat diagonal, elongately oval; peristome thin, simple, straight, margins regularly arched, the columellar margin thickened with callus, twisted, reflected and running spirally inwards, joining the thin white lunate-shaped tooth placed in the body-whorl. Length 1½ breadth ¾ line'' (*Brazier*).

Home Islands, North-East Australia; Albany Island, Cape York (Chevert Exped.).

Tornatellina grenvillei Braz., Proc. Linn. Soc. N. S. Wales, i, 1876, p. 109.

43. T. noumeensis Crosse. Pl. 38, figs. 3, 4.

Shell imperforate, ovate-conic, thin, pellucid, a little shining, brownish-corneous. Spire moderately long, the apex rather obtuse; suture impressed. Whorls 5, a trifle convex, smooth, the last a little longer than the spire, somewhat rounded at the base. Aperture suboblique, semioval, colored like the outside. Parietal lamella horizontal, entering, whitish. Peristome simple, the columellar margin one-plicate, whitish, basal and outer margins acute. Length 2½, diam. 1¼ mm. (*Crosse*).

New Caledonia: Ilot Maitre near Noumea (Marie coll.). Also Lifu, Loyalty Is. (Lambert).

Tornatellina noumeensis Crosse, Journ. de Conchyl., xviii, 1870, p. 244; xix, 1871, p. 193, pl. 6, f. 4; 1894, p. 305.—Pfr., Monogr., viii, 318.—Gassies, Faune Conch. N. Caled., ii, 1871, p. 95, but not the figure.

This form is closely related to *T. novoseelandica,* but differs by its broader, more conic shape. Figured from specimens received from M. Marie. Crosse's figure (copied in fig. 3), is not satisfactory. The color of fresh shells is corneous-chestnut. Others are clear whitish-corneous, but they may be bleached. *Cf. T. mastersi* Braz., which differs specifically, we think, by its lower parietal lamella.

4. *Philippine and East Indian Archipelagos.*

Several of these forms stand in need of further elucidation, their relationships being imperfectly known from the published descriptions.

44. T. kochiana Moellendorff. Pl. 38, figs. 14, 15; pl. 40, figs. 11, 12.

Shell imperforate, ovate-conic, thin, minutely striatulate, olivaceous-corneous. Spire conic, the apex somewhat acute. Whorls 5, convex. Aperture lunate-oval; peristome unexpanded, acute. Parietal lamella rather strong, entering deeply. Columella strongly twisted spirally, truncate at base. Length 3.25, diam. 1.75 mm. (*Mlldff.*).

Philippines: at the town of Cebu, on plants (O. Koch).

Tornatellina kochiana Mlldff., Malakozoologische Blätter n. F., x. 1888, p. 163, pl. 4, f. 11.

Smaller and somewhat wider than *T. manilensis* Dohrn, not smooth, but distinctly though finely striate, the columella is strongly twisted and distinctly truncate below, while in *manilensis* it is said to be scarcely truncate (*Mlldff.*).

The original figures are copied on plate 38. A specimen 2.9 mm. long is drawn on pl. 40, figs. 11, 12. It needs further comparison with *T. manilensis,* which has been placed in *Elasmias,* on account of the comparisons made in Dohrn's description.

45. T. MOLUCCANA O. Boettger. Pl. 38, figs. 12, 13.

Differs from *T. oblongata* [*sic*] Pse. by the smaller, more cylindric-oblong shell, the parietal lamellæ more approaching the columella. Shell small, imperforate, subregularly elongate-oblong, thin, glossy, corneous-brown. Spire turrite-convex, the apex rather obtuse. Whorls 5½, a little convex, separated by a lightly impressed suture, obsoletely striatulate in groups, the last whorl flattened in the middle, two-fifths the length of the shell. Aperture a little oblique, auriform, unilamellate, the parietal lamella extremely strong, compressed, subtransverse, approximating the columella. Peristome simple, acute, the right margin rather straightly descending, columellar margin sigmoid with a twisted callus, wider and flattened at base, but not toothed. Length 2⅜, diam. 1, alt. apert. 1, width ⅝ mm. (*Bttg.*).

Southern Amboyna: Ema (Strubell).

Tornatellina moluccana BTTG., Bericht Senckenbergische Naturforschende Gesellschaft in Frankfurt am Main, 1891, p. 274, pl. 4, f. 1.

Among the few species accessible to me only the Polynesian *T. oblongata* Pse. is closely comparable, but that is certainly diverse specifically by the conic-oblong, not wholly oblong contour, with more pointed apex (*Bttg.*). The original figures are copied.

46. T. CAMARINICA Moellendorff. Not figured.

Shell imperforate, slenderly oblong-oval, thin, slightly striatulate, yellowish-corneous. Whorls 4½, a little convex. Aperture nearly vertical, acuminate-oval; peristome unexpanded, acute. Parietal lamella emerging, rather strong, entering deeply. Columella strongly twisted spirally, fold well developed, spirally receding. Length 3, diam. 1.5 mm. (*Mlldff.*).

Philippine Is.: Village of Caramuan, province Camarines, Luzon.

Tornatellina camarinica MLLDFF. Nachrichtsblatt d. Deutschen Malak. Gesellschaft, vol. 27, August, 1895, p. 117.

Species of Juan Fernandez and Masafuera.

None of these forms are known to us by specimens, and we are ignorant of their relationships to Polynesian species. In view of the remoteness of these Chilian Islands from the Pacific archipelagoes, a new investigation of their land faunas, which are at least partially of Pacific type, is highly desirable. It should be noted that there are related shrubby Compositæ and other plants in Hawaii, Tahiti and Juan Fernandez, and that the genus *Fernandezia* stands very close, in conchological characters, to the Hawaiian *Leptachatina*.

T. bilamellata, no. 1, has been reported from both Juan Fernandez and Opara. *T. trochlearis*, no. 35, from Opara and Masafuera. There seems to have been an early mixture of shells from these distant localities.

Leptinaria lacryma and *L. succinealis* Beck, Index Molluscorum, 1837, p. 79, from Juan Fernandez, are probably Tornatellinas. Neither has been defined in any way.

47. T. MINUTA (Anton). Pl. 40, fig. 7.

Long-oval, spire lengthened, not ventricose, last whorl as large as the others together; somewhat glossy, finely striate, light brown; aperture long-oval. Breadth ⅓, height 1¼ lines (*Anton*).

Juan Fernandez (Anton).

Achatina minuta ANTON, Verzeichniss, etc., 1839, p. 44, no. 1592.—*Tornatellina minuta* Anton, PFEIFFER, Symbolæ ad Hist. Hel., ii, 1842, p. 130; Monographia, ii, p. 392.—KUESTER, Conchyl. Cabinet, *Pupa*, p. 150, pl. 18, figs. 14, 15.

The figure is copied from Kuester. Pfeiffer described a specimen received from Anton as follows: Shell ovate-oblong, very finely striatulate, pellucid, corneous, glossy; spire turrite-conic, apex a little obtuse; whorls 5½, a little convex, the last about two-fifths the total length. Aperture oblong, subauriform, contracted by a strong white lamella on the parietal wall and a callously twisted columella; peristome acute. Length 3, diam. 1½ mm., aperture 1⅓ mm. long.

Section ELASMATINA Petit.

Strobilus ANTON, Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinden, p. 46 (as a subgenus of Clausilia). Not *Strobila* Sars.—"*Strombilus* Alton, 1839," GRAY, P. Z. S., 1847, p. 175, type *St. turritus.*—*Elasmatina* PETIT, P. Z. S., 1843, p. 2.—GRAY, P. Z. S., 1847, p. 175, type *E. subulata.*

The shell is very long, slender, turrited or conic, composed of 9 to 10 flattened whorls; aperture armed with a strong parietal lamella; columella simple or lamellate. Type *T. turrita* Anton.

Both *Strobilus* and *Elasmatina,* as instituted by Anton and Petit respectively, were heterogeneous groups, comprising elongated, conic and globose species; but Gray, in his "List of the genera of recent mollusca, their synonyma and types," P. Z. S., 1847, fixed upon the first species of each, *S. turritus* and *E. subulata,* as the sole types of these groups. Since these two names were applied to one and the same species, the two supposed genera must be united.

We do not know that the locality of *T. turrita* has been verified by specimens collected since Anton's original lot. This is rather important on account of the uncertainty of some of the habitats given by him. *T. turrita, T. reclusiana, T. conica* and *T. trochiformis* agree in having numerous whorls and similar apertural lamellæ, and it seems likely that all belong to the same group. *T. trochlearis,* no. 35, also resembles these species, except that it has fewer whorls. Its locality is uncertain. It may possibly turn out that *T. turrita* is from Juan Fernandez, and not from Opara. *T. bilamellata* differs from the shells under consideration by having a pair of palatal plicæ, but its relations to the other species have not been determined. Having none of these species at hand, we cannot formulate a definite classification.

48. T. TURRITA (Anton). Pl. 53, fig. 15.

Turrited, elongate, of 9 narrow whorls, the last a little larger than the penultimate, moderately convex; suture deep. Aperture acutely oval with a lamella on the columella. Thin,

finely striate, glossy, light-brown. Length 2¼, breadth three-fifths lines (*Anton*).

Shell turrited, thin, very finely striatulate, pellucid, glossy, pale-corneous. Spire long, the apex rather obtuse. Whorls 9 to 10, a little convex, regularly increasing, the last about one-fourth the length, suture impressed. Aperture obliquely oboval, edentulous except for a strong horizontally entering lamella on the parietal wall of the aperture. Peristome simple, acute. Length 6, diam. 2 mm., oblique length of aperture 1.5 mm. (*Pfr.*).

Rapa (Opara) Island.

Strobilus turritus ANTON, Verzeichniss, etc., 1839, p. 46, no. 1691.—*Tornatellina turrita* Ant., KUESTER, Conchyl. Cab., p. 153, pl. 18, f. 22, 23.—PFR., Monogr., ii, 391; iii, 526; iv, 652; vi, 263.—*Tornatellina archimedis* BECK, Index Moll., 1837, p. 80 (nude name), *teste* Anton.—*Balea turrita* Ant., PFR., Symbolæ, ii, p. 55.—*Elasmatina subulata* PETIT, P. Z. S., 1843, p. 2.

The figure is from Kuester. This species is the type of *Strobilus* Anton and *Elasmatina* Petit.

49. T. RECLUSIANA (Petit).

Shell oblong-conic, pellucid, corneous-brownish; whorls 9-10, somewhat flattened; aperture semilunar; columella twisted-plicate at the base, the fold lamellose; lip thin, acute. Length 5, diam. 2 mm. (*Petit*).

Masafuera, under moss in damp situations (Cuming).

Elasmatina reclusiana PETIT, Proc. Zool. Soc. London, 1843, p. 2 (July, 1843).

This species belongs, perhaps, to the section *Elasmatina*, together with the two following.

50. T. CONICA (Anton).

Conic; base flat; 7 flat whorls with deep suture; aperture very broad; columella with a lamella, a second one on the base of the penult. whorl; horny-brown, shining; somewhat less fragile than the others. Breadth 1¼, height 1¾ lines (*Anton*).

Juan Fernandez (Anton).

Strobilus conicus ANTON, Verzeichniss, etc., 1839, p. 46, no. 1696.

Said by Pfeiffer to be the young of *T. trochiformis*; if so, the name *conica* has priority.

51. T. TROCHIFORMIS 'Beck' Pfeiffer. Pl. 53, fig. 14.

"Shell conic, subtrochiform, striate, a little shining, corneous; whorls 10, flat, the last carinate, scarcely one-third the total length; aperture short, lunate; columella having a double lamelliform tooth at the base; peristome simple. Length 4½, diam. 2⅔ mm. Opara, Anton (*Pfr.*, 1842).

"Shell conic, subtrochiform, thin, striatulate, pellucid, glossy, brown-corneous; spire conic, apex acute; suture linear, submargined; whorls 10 to 11, narrow, flat, the last not half the total length, carinate, the base a little convex. Aperture depressed, lunar, having a low lamina on the parietal wall and a horizontal fold winding inwards on the very short columella; peristome acute. Length 5 to 6, diam. 3 to 3¼ mm., oblique length of aperture 2 mm. Island of Juan Fernandez" (*Pfr.*, 1848).

Tornatellina trochiformis BECK, Index Molluscorum, p. 80, no. 2, 1837, nude name.—PFR., Symbolæ, 1842, ii, p. 55; Monographia, ii, p. 392; iii, p. 525; iv, p. 651; vi, p. 263.—KUESTER, Conchylien Cabinet, *Pupa*, p. 154, pl. 18, figs. 28, 29.—E. A. SMITH, P. Z. S., 1884, p. 280 (Juan Fernandez, Challenger Exped.).—*Strobilus fissidens* Mühlf., Anton, Verzeichniss. p. 46, no. 1695, undescribed, according to Pfeiffer.—*Elasmatina cumingiana* PETIT, Proc. Zool. Soc. Lond., 1843, p. 2 (July, 1843).

This species was first defined by Pfeiffer, who gave the locality *Opara*, on Anton's authority. Subsequently he corrected it to Juan Fernandez, and gave a new description. He also, in the *Monographia*, stated that *Strobilus conicus* Anton was the young of *trochiformis*, doubtless from an examination of Anton's type. *E. cumingiana*, which Pfeiffer considered a synonym of *trochiformis*, is thus described.

"*Elasmatina cumingiana*. Shell ovate-conic, pyramidal, pellucid, dilute corneous-brownish; whorls 10-11, subplanu-

ulate, the last subangular; aperture semilunar, narrow; columella biplicate, the superior fold obsoletely lamelliform, the inferior arcuate, lamellose; lip thin, acute. Length 6, width 3¼ mm. Island of Juan Fernandez. Found by Mr. Cuming on dried herbage'' (*Petit*).

Position uncertain. TORNATELLOIDES Pfr.

Tornatelloides PFEIFFER, Monographia Heliceorum Viventium, viii, p. 299, for *F. achatinoides, fraseri, microxia, diodonta, hierosolymarum, rothi, moussoniana, unidentata, ovuliformis* (1877).—PILSBRY, Man. Conch., xix, p. 285 (type *achatinoides*).—*Tornatellinoides* PFR., Nomenclator Hel. Viv., 1878, p. 338, for the same species, except *ovuliformis*.—TRYON, Struct. and Syst. Conch., iii. 1884, p. 62 (for *C. achatinoides* Pfr.).

This group was introduced by Pfeiffer for species of *Ferussacia, Calaxis,* and one species, *T. achatinoides,* said to be from the Gambier Islands, known to us only by the original account, translated below. In 1878 Pfeiffer altered the spelling of the name, and Tryon (1884) followed him, mentioning *T. achatinoides* as an example of the group. It may turn out to be a *Ferussacia* from northern Africa, the locality assigned resting only upon the perilous authority of a Cumingian label.

T. ACHATINOIDES Pfeiffer.

Shell oblong, subcylindric, rather solid, smooth, pale-corneous spire long, tapering above, rather acute, suture submarginate. Whorls 7, rather flat, the last two-fifths the total length. Parietal lamella small, deeply placed. Columella bituberculate, subtruncate. Aperture subvertical, rhombic-semioval; peristome simple, obtuse. Length 12, diam. 4 mm., aperture 5 mm. long, 2½ wide in the middle (*Pfr.*).

Gambier Islands (Cuming).

Tornatellina achatinoides Pfr., P. Z. S., for 1852, p. 68 (1854); Monogr. Hel. Viv., iii, p. 525 (May, 1853).—?*Tornatellina* . . . REEVE, Conch. Icon., v, *Achatina,* pl. 19, f. 102 (June, 1849).—*Cionella* (*Tornatellinoides*) *achatinoides* PFR., Nomencl. Hel. Viv., 1878, p. 339.

This species is known only by the above description and a nameless figure, without locality, in Reeve's *Iconica,* which Pfeiffer referred with doubt to *T. achatinoides.* The shell may possibly turn out to be a *Ferussacia* from northern Africa.

Genus TORNATELLIDES Pilsbry.

Tornatellides Pils., Nautilus xxiii, March, 1910, p. 123, type *T. simplex* Pse.

The shell is small, dextral, ovate-conic or oblong, *perforate or umbilicate* in all post-embryonic stages; thin. Aperture ovate, armed with a parietal lamella and one or two columellar lamellæ (often wanting in the adult stage); palatal wall simple. *Reproduction viviparous.* Mantle maculate with black.

Type *T. simplex* Pse. Distribution, Islands of the Pacific.

Tornatellides closely resembles *Tornatellaria.* The original definitions of the two groups were not diagnostic for the entire series now known; but the observation first made by the junior author that the species of *Tornatellides* are viviparous, while the *Tornatellariæ* are oviparous, like *Auriculella,* confirmed the distinction, and cause us to rank both groups as genera. This distinction is not so difficult of application as might be supposed, for the dry shells of *Tornatellides* usually will be found to contain embryo shells when broken open. Even fossil shells often contain them. Moreover, except in the group of *T. cyphostyla,* the whorls are more convex in *Tornatellides,* the base is convex or saccate, and the periphery is not angular. One soon learns to distinguish the two genera on sight, with very few exceptions. The generic position of nearly all the species has been verified by finding the embryos.

Specific characters.—The species of this genus show a greater differentiation than those of any of the other genera of the family. The axis of *Tornatellides* is invariably hollow up to the initial whorl. The perforation is sometimes quite small throughout the immature stages, suddenly widening at the last whorl. In other forms it is widely open from the first, appearing well-like, viewed from below, and not rapidly enlarging in the last whorl. The number of whorls varies from

T. confusa with 5, to *T. terebra* with 8½. The embryonic whorls are smooth or faintly sculptured with minute raised spiral lines. The remaining whorls vary from nearly flat to quite convex. It is, however, in the characters of the aperture that the greatest differences are found. The parietal lamella, in adult specimens, may be strong and oblique or it may be present as a weak raised line, which in individual cases is almost absent. In a few species the parietal lamella is irregularly eroded in all adult specimens. In the group of *T. terebra* the outline of this lamella is serrate, with strong, spine-like, outwardly projecting points. In adult specimens, the columella is sometimes unarmed. Usually it is furnished with one or two folds. Immature specimens of a few species have the columella furnished with a single oblique thread-like fold, but in most of the species immature specimens have two nearly parallel lamellæ on the columella. In some of the species belonging to the group of *T. euryomphala* the lower of these folds is very strongly developed and extends nearly to the middle of the aperture.

The genus is enormously differentiated and specialized in the Hawaiian Islands, where most of the species have columellar lamellæ in the neanic stage, sometimes continuing in the adult. Species from other islands, around the periphery of the Pacific, are more simple, either having no columellar lamellæ at any stage, or in the New Zealand species, having a small lower columellar lamella in the young. The few species from the Japanese Islands, New Zealand, Polynesia and the Galapagos are remarkably similar (see plate 44, all figures).

Distribution.—Fifty-five species of *Tornatellides* are now known (three or four of them of doubtful validity), distributed as follows:

Formosa and Japanese Islands, 2 or 3 species (no. 1 to 3).

Polynesia, Australasia, 3 to 5 species (no. 4 to 8).

Galapagos Islands, 1 species (no. 9).

Hawaiian Islands, 45 species (no. 10 to 54).

Laysan Island, 1 species (no. 15½).

The Polynesian species *T. simplex* occurs on several island groups, and dispersal by human agency may be suspected. Several Hawaiian species occur on more than one island:

T. macromphala, all the islands except Niihau.

T. procerulus, all the islands except Niihau and Kahoolawe, but with some racial variation.

T. perkinsi acicula, Oahu, Molokai, Lanai, Mani.

T. terebra, Molokai, Lanai, Maui, Hawaii.

A few others occur in slightly varying forms on two islands, and with increasing collections the number of species common to more than one island is likely to be considerably augmented. Each Hawaiian island has several species special to it, and the number of these will undoubtedly be increased also. Almost every new exploration contains unknown species of *Tornatellides*. It will be one of the largest Hawaiian genera.

Tornatellides is the only genus of the family yet found in the Galapagos Islands; and it is the only land snail of that fauna, as at present known, having Polynesian affinities. All the rest of the known snails are distinctly American.

Key to Groups of Tornatellides.

NOTE.—The keys are applicable to adult shells only.

a. Surface sculptured with irregular ribs or riblets.
  b. Whorls convex, the last having a spiral sulcus (Subgenus *Waimea*). *T. rudicostatus*, no. 54.
  b[1]. Whorls flattened. *T. insignis*, no. 26.
a[1]. Surface smooth.
  b. Parietal lamella entire.
    c. Base abrupt, subtruncate; umbilicus large. *Group of T. perkinsi*, p. 223.
    c[1]. Base not abrupt or truncate.
      d. Whorls convex; base rounded.
        e. Columella without lamellæ or folds in adults.
          f. Neanic stage having a single columellar lamella or none. *Group of T. simplex*, p. 195.
          f[1]. Neanic stage having two distinct columellar lamellæ. *Group of T. euryomphala*, species nos. 38, 40, 42, 48.

c^1. Columella with one or two rather weak folds or lamellæ in the adult stage (two in the young).

f. Columella with two lamellæ (the upper stronger), or with only an upper lamella or fold.

Group of T. euryomphala, p. 230.

f^1. Columella with the lower lamella only.

T. oncospira, no. 19.

c^2. Columella with two rather strong, oblique lamellæ in both young and adult.

Group of T. thaanumi, p. 215.

Group of T. euryomphala, species nos. 39, 46, 47.

d^1. Whorls flat; the base tapering.

Group of T. cyphostyla, p. 217.

b^1. Parietal lamella irregularly eroded; columella unarmed. *T. irregularis*, no. 38.

b^2. Parietal lamella regularly serrate or bearing a scythe-like process. *Group of T. terebra*, p. 243.

Group of T. simplex.

Tornatellides with rather few (4½ to 6), more or less convex whorls. Columella unarmed in adults (except in *oncospira*, which has a deeply seated lower columellar fold). In immature specimens *only the lower columellar lamella or fold is developed as such*, when the upper fold is present it is represented by an oblique swelling. In some species there seem to be no columellar lamellæ at any stage. The parietal lamella of immature specimens is usually much stronger than that of adults, but sometimes it is only slightly so.

1. *Species of Formosa and the Japanese Islands.*

It should be mentioned that G. Nevill reports an undetermined species of "*Tornatellina*" from Shanghai—the only record we have for a member of this family on the mainland of Asia.

1. T. BOENINGI (Schmacker et Boettger). Pl. 44, figs. 5, 6, 7.

Shell widely perforate, conic-turrite, thin, diaphanous, glossy, pale corneous-brown. Spire almost exactly long-conic, the apex rather acute. Whorls 6, a little convex, slowly increasing, parted by a distinct suture, striatulate; the last whorl moderately inflated, rotund, especially rounded-subcristate around the umbilicus, almost one-third the alt. of the shell. Aperture oblique, truncate-oval, with one lamella. Peristome unexpanded, simple, the margins distant, right margin regularly curved, columellar margin triangularly dilated above, protracted. Columella vertical, hardly twisted, a little convex. There is a thin, low lamella in the middle of the parietal wall, entering far within. Length 3¼, diam. 1⅞, alt. aperture 1¼, width ⅞ mm. (*S. and B.*).

Formosa: Tamsui (Mr. G. Degener-Boening).

Tornatellina boeningi S. & B., Nachrichtsblatt d. Deutschen Malak. Ges., xxiii, December, 1891, p. 180, pl. 2, f. 7.

2. T. INEXPECTATUS (Pilsbry). Pl. 44, figs. 1, 4.

The shell is umbilicate ovate-pyramidal, cinnamon colored or paler, glossy, growth-lines faint; outlines of spire straight. Whorls 5¾, not very convex, the last rounded at the periphery, convex below. Aperture irregularly ovate. Parietal lamella very low, nearly a half-whorl long. Peristome thin; columella slightly convex, outwardly broadly dilated and reflexed. Length 3, diam. 1.7 mm.

Loochoo (Ryukyu) Islands: Great Loochoo (Yaeyama), type loc.; Kume-jima; Okinoerabushima (Hirase). Islands of Izu: Hachijo-jima and Miyake-jima (Hirase). Types no. 80970 A. N. S. P.

Tornatellina inexpectata PILS., Nautilus, xv, p. 23 (June, 1901).

There are no columellar lamellæ at any stage of growth. While this shell appears to be a little less turrited than *T. boeningi* of Formosa, and not especially prominent around the umbilicus, yet it seems likely that the two are not specifically distinct. Formosan specimens should be compared with the Loochooan.

A few immature shells from Kitaiwo-jima, Sulphur Is., seem to belong to this species, which has a rather remarkable distribution. Some of the other small shells of the islands of Izu are closely related to Loochooan species.

3. T. TRYONI P. & C., n. sp. Pl. 44, figs. 2, 3.

Shell minute, conic, rather openly umbilicate, thin, pale corneous-brown, subtranslucent, smooth, except for slight growth-lines, glossy. Outlines of spire straight, the apex obtuse. Whorls 5¼, not very convex, the last well rounded at the periphery and beneath. Aperture irregularly ovate, slightly oblique, the peristome thin, outer lip unexpanded, columellar margin rather broadly dilated and somewhat reflexed. Columella a little convex, vertical. Parietal wall bearing a very small, short, thread-like, median, entering lamella. Length 3, diam. 2 mm.

Bonin Is. (Ogasawara-jima): Haha-jima, type loc., Ani-jima, Nakano-jima and Mei-jima (Hirase). Type no. 82669 A. N. S. P.

Decidedly stouter in figure than *T. boeningi* or *inexpectatus*, with a much smaller and shorter parietal lamella. Named for George W. Tryon, Jr., founder of the MANUAL.

2. *Species of Polynesia to New Zealand, etc.*

T. pusilla (Gould) was described as perforate, but there is reason for thinking this an error of observation. See p. 176.

4. T. SIMPLEX (Pease). Pl. 44, figs. 8, 9, 10.

Shell conic-ovate, broadly umbilicate, thin, pellucid, glossy, brown-corneous; spire conic, acute; whorls 5, convex, the last hardly half the length of the shell; suture impressed; aperture subauriform; lip thin, acute; columella widely reflexed above, base rounded. Length 3, diam. 1½ mm. (*Pease*).

Society Islands: Tahaa (type loc.), Tahiti, Huaheine (Garrett). Marquesas (C. D. Voy). Cook's Is.: Rarotonga (Garrett).

"This species is distributed throughout all the groups of islands in southeastern Polynesia; on the ground, in forests" (Garrett).

Tornatellina simplex PEASE, Proc. Zool. Soc. Lond., 1864, p. 673; 1871, p. 473.—PFEIFFER, Mon. Hel. Viv., vi, p. 266—GARRETT, Proc. Acad. Nat. Sci. Phila., 1879, p. 22; Jour. Acad. Nat. Sci. Phila., 1881, p. 398; ix, p. 82, pl. 2, fig. 21.—*Tornatellina Newcombi* var., SCHMELTZ, Cat. Mus. Godeffroy, vi, p. 80.

"Mr. Pease's type specimens were collected by me at Tahaa. He either overlooked or inadvertently omitted to mention the small, but constant, parietal lamina in his brief diagnosis. The open umbilicus, small parietal lamina, smooth and simple columella, will distinguish it from any other Polynesian species" (*Garrett*).

The embryonic stage has a very low parietal lamella but no columellar or palatal folds.

The half-grown stage has a simple columella like the adult. In comparing specimens from Rarotonga, Marquesas and several of the Society Islands, no differences of importance were noticed. The parietal lamella varies in strength in each lot, but is never wide. It is nearly a half-whorl long. The Huaheine and Rarotonga (fig. 10) shells are a little wider and more conic than most of those from Tahiti.

Length 3.2, diam. 1.8 mm. (Tahiti, fig. 8).

Length 3.1, diam. 1.8 mm. (Rarotonga, fig. 10).

5. T. OBLONGUS (Anton). Pl. 44, fig. 13.

"Oval, conoidal, rather long, 5 convex whorls. Suture deep. Apex acute. Aperture oval, with a flat fold on the columella. Glossy, transparent, delicate, brown. Length 1½, diam. ¾ lines.

"Var., more ventricose, shorter. Habitat Opana" (*Anton*).

Shell very narrowly umbilicate, ovate-conic, thin, glossy, pellucid, corneous. Spire acute. Whorls 5½, a little convex, the last two-fifths the total length. Columella straightened, vertical. Aperture suboval, slightly obstructed by an entering parietal fold. Peristome simple, acute, the columellar margin reflexed from the base, dilated-spreading above. Length 3, diam. 1⅔ mm., aperture 1⅓ mm. long, ⅔ wide (*Pfr., T. antoni*).

Austral Is.: Rapa (Opara).

Strobilus oblongus ANTON, Verzeichniss, p. 46, no. 1692 (1839).—*Bulimus antoni* PFR., Symbolæ ad Hist. Hel., i, p. 24 (1841) no description, new name based on *S. oblongus* Anton; ii, p. 43 (description); Monogr. Hel. Viv., ii, p. 221.—REEVE, Conch. Icon., *Bulimus*, pl. 80, f. 589.—*Tornatellina* (?) *Antoni* PFR., Nomenclator Hel. Viv., 1878, p. 343.

The original description is given above. Pfeiffer renamed the species because in *Bulimus* the specific name was already in use. His description from the *Monographia Heliceorum* is also given. The figure is copied from Reeve. Not seen by us. *Cf. T. simplex*, which may prove specifically identical with *oblongus*.

6. T. PERFORATUS (Liardet). Pl. 44, figs. 11, 12.

"Shell small, acute, polished, dark-brown color; epidermis thin; whorls 5½, convex, spirally striate, with a white apertural lamina; aperture oblique, pyriform; columellar lip white, projecting from the base of the shell, expanding slightly over region of umbilicus; outer lip impressed and of a deep purple tint.

"This shell is found embedded in the bark of dead logs. The animal has the tips of the eye-pedicels bulbous" (*Liardet*).

Fiji Is.: Taviuni (coll. Liardet).

Lamellaria perforata LIARDET, Proc. Zool. Soc. Lond., 1876, p. 101, pl. 5, f. 8, 8*a*.

From the figure this seems to be somewhat more lengthened than *T. simplex*. No dimensions are given, but the length is indicated on the plate as 4½ mm. The generic name used by Mr. Liardet may have been an error for *Lamellina*, since *Lamellaria* is a well-known genus of marine gastropods.

7. T. SUBPERFORATUS (Suter). Pl. 44, figs. 14, 15.

"Shell very small, conoidal, sub-perforate, thin, pellucid, shining, light-corneous. The only sculpture consists of fine oblique growth-lines. Color very light horny. Epidermis very thin, light-brown, very easily rubbed off. Spire elevated

conic, a little higher than the aperture. Protoconch globose. Whorls 5, convex, the last rapidly increasing, ventricose; base rounded. Suture impressed, faintly and narrowly margined. Aperture subvertical, ovate, angled above. Peristome thin, sharp; outer lip moderately convex, basal lip narrower, arched. Columella vertical, not twisted; inner lip thin, broadly reflexed above, and partly concealing the very narrow and not deep perforation. Parietal wall with an entering median small lamella. Diam. 2.2, height 3.5 mm." (*Suter*).

New Zealand: Whangarei (type loc., C. Cooper); near Auckland (H. Suter, S. W. Wright).

Tornatellina subperforata SUTER, Proc. Malac. Soc. London, viii, 1909, p. 263; pl. 11, f. 30; Manual of the New Zealand Mollusca, 1913, p. 769.

The inflated body-whorl, the straight, not tortuous columella, and the narrow perforation separate it at once from *T. novoseelandica* Pfr. Type in my collection" (*Suter*).

The umbilicus is somewhat smaller than in *T. simplex*; as usual it penetrates to the first whorl, and is therefore as deep as in other *Tornatellides*. The parietal lamella is rather short in the adult stage. In the neanic stage, 2.2 mm. long, of 4 whorls, the parietal lamella is wider and fully a half-whorl long, and there is a distinct though small and strongly oblique lamella near the base of the columella (fig. 14).

7*a*. *T. subperforatus kermadecensis* n. subsp. Pl. 44, fig. 16.

Shell more slender, with a smaller summit.

Kermadec Is.: Sunday or Raoul Island (Tom Iredale).

Mr. Suter has reported *T. subperforata* from Raoul, collected by Miss Shakespear. The single specimen sent by Mr. Iredale is not adult, but it differs from *subperforata* of similar length by the narrower contour and more slender apex. It is corneous-whitish; parietal lamella well developed, fully a half-whorl long; columella minutely biplicate. Length 2.5, diam. 1.5 mm., 4¾ whorls.

8. T. INCONSPICUUS (Brazier).

"Shell somewhat perforate, rather turrited, very thin,

transparent, shining, moderately smooth, with very faint oblique striæ (as seen under the lens), bright yellowish horn-color; spire very little elongated, obtuse at the apex; whorls 5, convex, impressed at the suture, the last equaling about half of the length; aperture ovate, with a thin central vertical tooth; columella twisted and entering spirally; peristome simple; acute. Length 1 line, diam. ½; length of aperture ½ line" (*Brazier*).

Lord Howe's Island (*Brazier*).

Tornatellina inconspicua Brazier, P. Z. S., 1872, p. 619; Memoirs of the Australian Mus., no. 2, p. 27.—Pfr., Monogr., viii, p. 319.—Hedley, Records of the Australian Mus., i, p. 142.

We learn from Mr. Hedley's publication that the "type was deposited in the Australian Museum, but has been accidentally destroyed. Habitat, a gully on the North Ridge among dead leaves, rare." It has not been figured. The columella, "twisted and entering spirally", raises a suspicion that this species is a *Tornatellinops*, and not really "somewhat perforate"; yet the one observation is as likely to be wrong as the other.

3. *Galapagos species.*

The occurrence of *Tornatellides* in the Galapagos is unexpected, though it is not the only Pacific element in the fauna of American islands. Juan Fernandez and Cocos Island (see Manual, Vol. XVIII, p. 325, XXI, p. 93, and this volume, p. 187) also have some Polynesian or Micronesian genera.

9. T. chathamensis (Dall). Pl. 44, figs. 17, 18, 19.

"Shell small, horn-colored, with a blunt apex and six rounded whorls; suture very distinct; surface polished, delicately marked with lines of growth; base rounded, relatively rather widely umbilicated. Aperture with the margin hardly thickened, rounded in front and at the suture; pillar broad, thin; body with a single elevated, thin, sharp lamina, extending spirally inward from a point a little behind the peristome and nearly equidistant from the inner and outer lips. Alt. of shell 3.0, max. diam. 1.6 mm." (*Dall*).

Galapagos Is.: Chatham Island, on ferns at 1,600-2,000 ft. above the sea; South Albemarle Island on dry bones of tortoises (Baur); Iguana Cove, Albemarle Island (Snodgrass and Heller).

Leptinaria chathamensis Dall, Nautilus, v, 1892, p. 98; Proc. Acad. Nat. Sci. Phila., 1896, p. 451, pl. 16, f. 9; pl. 17, f. 16.—Stearns, Proc. U. S. Nat. Mus., xvi, 1893, pp. 418, 428. —*Bulimulus* (*Pelecostoma*) *cymatoferus* Reibisch, Isis, 1892, pt. 3, p. 14, pl. 2, f. 7 (Chatham Is., Wolf).—*Tornatellina chathamensis* Dall, Proc. A. N. S. Phila., 1900, p. 95.

A copy of the original figure of *B. cymatoferus* is given in fig. 18. Fig. 17 is a copy of Mr. W. G. Binney's sketch of a tooth of *T. chathamensis*.

4. *Hawaiian species.*

Key to Hawaiian species of the Group of T. simplex.

This Hawaiian group comprises species with relatively simple apertural armature, similar to those of Polynesia and other islands. The other Hawaiian groups are all special to that archipelago.

a. Parietal lamella of adults very low, less than 0.07 mm. in height.

b. Adult shells more than 3 mm. in length.

c. Diameter less than 50 per cent of the length.

d. Adult shells more than 3.6 mm. in length, umbilicus rather large, aperture diagonal. *T. konaensis*, no. 17.

d[1]. Adult shells less than 3.3 mm. in length, umbilicus narrow, aperture not diagonal. *T. kahoolavensis*, no. 16.

c[1]. Diameter half the length; 3 x 1.5 mm., with 6 whorls; umbilicus larger than that of *kahoolavensis*. *T. kahukuensis*, no. 14.

c[2]. Diameter about 55 per cent. of the length; 3.5 x 2 mm. *T. procerulus*, no. 11.

c[3]. Diameter about 65 per cent. of the length; 3.3 x 2.1 mm. *T. kilauea*, no. 13.

b^1. Adult shells less than 2.7 mm. in length.

c. Adult shells rather narrowly ovate-conic, diameter 56 per cent or less of the length, which is about 2.5 mm.

d. Outlines of spire slightly convex; parietal lamella very low in the adult stage; Hawaii. *T. confusus*, no. 15.

d^1. Outlines of spire straight; parietal lamella moderate; Laysan I. *T. bryani*, no. 15½.

c^1. Adult shells broadly ovate, diameter 56-65 per cent of the length. *T. compactus*, no. 10.

a^1. Parietal lamella of adults moderately or well developed, more than 0.10 mm. in height.

b. Parietal lamella of adults moderately developed less than 0.15 mm. in height.

c. Shell conic.

d. Umbilicus rather ample. *T. subangulatus*, no. 18.

d^1. Umbilicus smaller, aperture wider. *T. inornatus*, no. 20.

c^1. Shell oblong-conic, aperture ovate.

d. 3.5 x 2 mm. *T. procerulus*, no. 11.

d^1. Smaller and narrower, parietal lamella larger. *T. kamaloensis*, no. 12.

b^1. Parietal lamella strongly developed, more than 0.17 mm. in height, apex blunt. *T. oncospira*, no. 19.

TORNATELLINA VITREA.—"*T. vitrea* Pease I find nowhere described. It is closely related to *T. newcombi Pfr.*, but is smaller, more ovate; the 6 whorls are convex, the last rounded on the base. The umbilicus is narrower. The lamella on the parietal wall is small, and the columella is cylindrical and without folds. Sandwich" (*Dohrn*).

Cionella (*Tornatellina*) *vitrea* Pease, PAETEL, Catalog, p. 107 (name only).—*Tornatellina vitrea* Pease, DOHRN. Malak. Bl. x, 1863, p. 162.

From the above descriptive notes, *T. vitrea* must be a

species of *Tornatellides*, probably a form related to *T. procerula* Anc. No specimens so labeled can be found in the Pease collection, and in the absence of a recognizable description the species must be discarded. The account applies equally well to several species.

10. T. COMPACTUS (Sykes). Pl. 45, figs. 1, 2, 3.

"Shell perforate, ovate, brownish-corneous, a little shining, thin. Spire short, the apex rather obtuse. Whorls 5 to 5½, well marked with growth-lines, a little convex, regularly and slowly increasing, the suture well impressed. Aperture ovate-piriform, often provided with a single minute lamella. Peristome simple, the columellar margin reflexed and expanded. Length 2.2, diam. 1.2 mm." (*Sykes*).

Hawaii: Mauna Loa at 2,000 ft. on hilo grass (Perkins), Hilo (Thaanum, Cooke), Kaiwiki (Thaanum), Hamakua (Ancey), Kapua district of Kona (Forbes). Type in British Museum, cotypes no. 13993 Bishop Museum.

Tornatellina compacta SYKES, Faun. Haw., ii, Moll., p. 380, pl. 11, f. 1 (1900).—HENSHAW, Journ. of Malacology, xi, 1904, p. 64.—ANCEY, t. c., p. 70.

"A compressed, compact little form, the aperture measuring about two-fifths of the length. The whorls are somewhat convex" (*Sykes*).

One of the cotypes, received from Sykes, has 4½ whorls. It measures: length 2.15, diam. 1.5, axis of aperture 1.1 mm. Shells from Kapua, though slightly darker brown, are identical with the typical form. An adult specimen (pl. 45, fig. 1) has 4¾ whorls. The embryonic whorls, as is also the case of the typical form, are not spirally striate. The suture of the embryonic shell is remarkably deep for a *Tornatellides*. The transverse striæ of the postembryonic whorls are almost regular and between them are numerous very fine striæ. An adult specimen with 4¾ whorls measures: length 2.15, diam. 1.4, axis of apert. 1.0, par. lam. 0.04, umb. 0.43 mm.

In an immature shell with 4 whorls the columella is furnished with a minute, somewhat oblique, deeply-seated lower fold (fig. 3).

Shells from Hilo and vicinity are thinner, lighter colored, and smoother than typical specimens, and, besides, the embryonic whorls are minutely spirally striate. An adult shell with 5 whorls measures: length 2.5, diam. 1.4, axis of apert. 1.0 mm.

Typical *compacta* is not present in any of the fossil earth we have examined from Hamakua.

11. T. PROCERULUS (Ancey). Pl. 45, figs. 4, 5, 6.

"Shell of the group of *T. peponum*" [Ancey not Gould, see note below], "but more robust, oblong, thin, subpellucid, corneous, obsoletely marked with fine growth-lines, openly perforate, the perforation minute but distinct. Spire longconoid, rather obtuse. Whorls 6, a little convex, regularly and rather slowly increasing, the last regularly ovate, hardly angular. Aperture oblong, sublunate, tapering above, slightly oblique. Parietal wall provided with a small median lamella. Columella unarmed but swollen. Peristome acute, the left margin triangularly expanded. Length 3.5, diam. 2, alt. apert. 1.33 mm." (*Ancey*).

East Maui: Kaupakalua, type loc. (Baldwin). Very common on all the islands except Kahoolawe. Cotypes no. 18442 Bishop Museum and 89843 P. A. N. S.; lectotype no. 36246 Bishop Museum.

Tornatellina procerula ANCEY, Journ. de Conchyl., li, 1903, p. 302, pl. 12, f. 13, 14; Journ. of Malac., xi, 1904, p. 69.—HENSHAW, t. c., p. 63.—*Tornatellina peponum* GLD., ANCEY, Bull. Soc. Malac. France, vi, 1889, p. 240; Journ. de Conchyl., li, 1903, p. 301.

"*T. procerula* is larger than *peponum*, of more robust form, but similar in other characters. In the young stage *T. peponum* has an acute columellar denticle which disappears with age. This peculiarity I have not noticed in *T. procerula*" (*Ancey*).

T. procerulus with *T. macromphala* and *Tornatellina oblonga* are the commonest species of *Tornatellinidæ* found on the Hawaiian Islands. These three species are abundant from near the seacoast, in favorable localities, to about 2,500 ft. ele-

vation. They are very often associated together. They are probably most often found on dead leaves on the ground, but are sometimes taken on the trunks of trees and shrubs, and, especially the first species, are sometimes abundant on the lower leaves of shrubs. They have been found also in some of the fossil deposits, as at Kahuku.

T. procerulus varies more than either of the other two species just mentioned. The colonies of different localities sometimes show conspicuous differences in size, color, texture of the surface and also in the height of the parietal lamella. With our present knowledge of this species it seems best to include all of the minor variations in a single species, but it will doubtless be subdivided into local subspecies eventually.

Ancey's identification of *T. peponum* (of which his original, 1890, examples are in the Bishop Museum) was clearly based upon specimens of one of the numerous forms of *procerula*. But this species is not found among Gould's figures or material. The only species represented in Gould's material of *peponum* in the collection of the Smithsonian Institution is the Hilo shell fortunately selected by Sykes and figured by us.

Ancey's type-specimen of *procerulus* was not isolated by him. The original lot contains more than 250 examples. A specimen (pl. 45, figs. 4, 5) from this lot has been selected to represent the species. It has 6 whorls and measures: length 3.5, diam. 1.9, axis of aperture 1.4, parietal lamella 0.14, umbilicus 0.33 mm. The embryonic whorls are smooth and have no indications of spiral lines.

In an immature shell with 4½ whorls the columella appears to be furnished with two folds. The upper fold is represented by a low, indistinct, oblique swelling; the lower is larger, transverse, about 0.1 mm. in height. The parietal lamella is strong, oblique, 0.16 mm. in height (fig. 6).

A specimen, in the Ancey collection, from Hamakua, Hawaii, and labeled in Ancey's handwriting "*T. peponum*", has 5¾ whorls and measures: length 3.3, diam. 1.8, axis of apert. 1.3, par. lam. 0.04, umb. 0.21 mm. The shell is slightly darker brown and the whorls are flatter than those of typical *procerulus*. In another lot, from Hilo, Hawaii, the shells are

lighter colored than the typical form and the parietal lamella is merely indicated by a faintly raised line. A form of *procerulus* is found on the crest of Kilauea.

In the Ancey collection is a series from Kaupakalua, East Maui, with the MS. name *T. peponum* var. *majuscula*. These are rather large fully adult specimens of *procerula*. One of the specimens with slightly more than 6 whorls measures: length 3.7, diam. 1.9, axis of apert. 1.5, par. lam. 0.13 mm.

Embryonic shells from an Oahuan form have the first whorl indistinctly spirally striate, the second whorl is faintly transversely striate. The shells are minutely perforate. The parietal lamella is low and the columella is unarmed.

11*a*. *T. procerulus puukolekolensis* P. & C., n. subsp. Pl. 45. figs. 7, 8.

More compact in form than *T. procerulus*, with the umbilicus very much larger. Length 3, diam. 1.8 mm., with 5½ whorls.

Molokai: in the bottom of a small ravine east of Puu Kolekole (Pilsbry & Cooke). Cotypes no. 108669 A. N. S. P. and 33669 B. P. B. Mus.

11*b*. *T. procerulus kailuanus* P. & C., n. subsp. Pl. 45, fig. 9.

The shell resembles *T. p. puukolekolensis* by the umbilicus, which is much larger than in *T. procerulus*. It differs from the Molokaian form by the thicker, more obtuse spire. The parietal lamella is quite low and nearly a half-whorl long. Length 2.9, diam. 1.7 mm.

Oahu: Kaelepulu, Kailua, in ledges and around the base of a low coral bluff (Pilsbry).

The umbilicus is much larger than in *T. kahoolavensis*.

12. T. KAMALOENSIS P. & C., n. sp. Pl. 45, figs. 10, 11.

The shell is perforate, oblong-conic, pale brown; spire straightly conic. Whorls 5½, convex. Aperture ovate, the columellar margin well reflexed, columella slightly convex. Parietal lamella nearly a half-whorl long, moderately high. Umbilicus minute. Length 2.8, diam. 1.5, length of aperture 1 mm.

Molokai: northwestern ravine of Kamalo, above the old Kamalo ditch trail (Pilsbry & Cooke). Types no. 108700 A. N. S. P., eotypes in B. P. Bishop Mus.

It is smaller, and espeeially narrower, than *T. procerulus,* with the parietal lamella better developed.

13. T. KILAUEA P. & C., n. sp. Pl. 45, figs. 12, 13.

The shell is rather narrowly umbilicate, ovate-conic, obese, light-brown, glossy. Spire straightly eonie with obtuse summit. Whorls 5⅓, moderately eonvex, the last rotund below. The aperture is irregularly ovate; parietal lamella very low, thread-like, about one-third whorl long. Columellar margin broadly dilated, simple. Length 3.3, diam. 2.1, aperture 1.4 mm.

A young specimen of 4½ whorls has a simple eolumella, like the adult. Earlier stages not seen.

Hawaii: crest of Kilauea crater, about half a mile south of the Volcano House (Dr. B. Sharp). Types no. 112737 A. N. S. P.

This species belongs to the *procerulus* group. It was found in eompany with the Kilauea form of *T. procerulus,* but differs from that by its far more obese figure. It is much larger than *T. oncospira, T. compactus* or *T. confusus.*

14. T. KAHUKUENSIS P. & C., n. sp. Pl. 46, figs. 11, 12.

The shell is oblong-turrited, umbilicate (the axial perforation minute, but at the last whorl enlarging to three times its previous size), cinnamon-brown. Outlines of the spire barely convex, apex obtuse. Whorls 6, moderately convex, the last sack-like below. Aperture truncate-ovate. Parietal lamella very low and slender, nearly a half-whorl long. Columellar margin dilated and simple. Length 3, diam. 1.5 mm.

Oahu: ledges near base of the "eoral bluff", 1½ miles west of Kahuku (Cooke & Pilsbry).

Decidedly more slender than *T. procerula,* whieh oeeurs with it. The umbilicus is larger than in *T. kahoolavensis,* whieh appears to be its nearest ally.

This Kahuku deposit, at least the superficial shell debris,

is quite recent, since part of the shells still retain their proper color, though none were collected alive. It contains, however, a number of species now believed to be extinct.

15. T. CONFUSUS (Sykes). Pl. 46, figs. 1, 2.

Shell perforate, narrowly ovate, brownish-corneous, transparent, thin, glossy, under a lens minutely and irregularly striate with lines of growth. Spire with slightly convex outlines, apex rather obtuse. Suture simple, well impressed. Whorls 5¼, the embryonic increasing rapidly, the rest convex, increasing irregularly, the last long, convex, tapering to the base. Aperture large, narrow, obliquely truncate-ovate. Parietal lamella very low, forming a slightly raised line. Columella narrow, slightly tumid above, without folds. Umbilicus very narrow, hardly circular, about one-fifth of the total diameter. Length 2.5, diam. 1.3, axis of apert. 1.05, par. lam. 0.02, umb. 0.26 mm.

Hawaii: Hilo (Gould, Thaanum, Cooke), Puna (Thaanum), Olaa (Cooke).

Pupa peponum GOULD in part, U. S. Exp. Exp. Moll., pl. 7, figs. 104 *a*, *b*, *c*.—*Tornatellina confusa* SYKES, Faun. Haw., ii, Moll., pp. 380, 382 (1900).—ANCEY, Journ. de Conchyl., li, 1903, p. 300.

The specimen chosen for our figure (pl. 46, fig. 1) of this species agrees very closely with Gould's figure 104*a*. The original of figs. 104*a*, *b*, *c* is lost, and we propose the shell drawn in our fig. 1 as type of the species as here rehabilitated. In the original figure the diameter is 52 per cent of the length and the axis of the aperture is 75 per cent of the diameter. In the selected specimen the diameter is 55 per cent of the length and the axis of the aperture is 80 per cent of the diameter. This species is very abundant in and around Hilo, and there is no doubt that Gould's figured specimen came from this locality. The figured specimen has the lowest parietal lamella of several hundred specimens examined by us. Usually the parietal lamella is about 0.05 mm. in height in front but it soon descends into a simple raised line in back.

An immature specimen with 4½ whorls has the columella

furnished, near its base, with a very oblique, low, deeply-seated fold; the upper columellar fold appears to be entirely absent. The parietal lamella is about 0.15 mm. in height. The embryonic whorls are encircled by very minute low spiral striæ (fig. 2).

Mr. Sykes based this species upon Gould's figure, but he also gave "Makaweli, Kauai", as the locality of specimens taken by Mr. Perkins. As no comparison of these Kauaian shells with topotypes from Hilo was made, and no description or figure of them was given, we may be permitted to hold that extension of its range as provisional until direct comparison can be made. At present *T. confusa* is known from Hawaii only.

15½. T. BRYANI C. & P., n. sp. Pl. 53, figs. 9, 10.

Shell perforate, narrowly ovate-conic, light corneous, glossy, under a strong lens minutely irregularly striate, thin, translucent. Spire elongate, conic, with slightly convex outlines, the apex obtuse. Suture impressed, simple. Whorls 5¾, uniformly convex, the embryonic increasing rapidly, the rest increasing slowly and regularly; the last whorl subcylindrical, rounded and tapering below, convex at the margin of the umbilicus. Aperture long-ovate, with a regularly curved outer margin. Parietal lamella low, erect, slightly sinuous along its upper edge. Columella tumid above, slightly convex below, unarmed. Peristome thin, erect, regularly arched. Umbilicus rather small, almost circular.

Length 2.5, diam. 1.4. axis of apert. 1.0. par. lam. 0.07, umb. 0.32 mm.

Length 2.7, diam. 1.5 mm.

Laysan Island, on bark about roots of bushes (Wm. Alanson Bryan). Type no. 39042 Bishop Museum, cotypes no. 22748 B. P. B. Mus. and 112734 A. N. S. P.

An immature specimen, with nearly 4½ whorls (fig. 10), has smooth apical whorls. The parietal lamella is rather strong, erect, about 0.12 mm. in height. The columella is narrowly triangular, with its inner margin almost straight and is furnished with a single low, almost transverse fold.

Of the Hawaiian species of *Tornatellides*, *T. bryani* is most closely related to *T. kahoolavensis*. It differs from the latter by its smaller size, straighter and more conical outlines of the spire, stronger parietal lamella, etc. This species was taken with *Tornatellina gracilis*, but was not nearly so abundant as that species.

16. T. KAHOOLAVENSIS C. & P., n. sp. Pl. 46, figs. 3, 4, 7.

Shell perforate, cylindrically turrited, in fossil state white, glossy, under a strong lens minutely striate, thin, translucent. Spire elongate, subcylindrical, with slightly convex outlines; apex subacute. Suture well impressed, indistinctly margined. Whorls 6, the embryonic increasing rapidly, smooth, the rest increasing very slowly and regularly, convex, the last cylindrical, rounded below, slightly flattened about the umbilicus. Aperture rather long, ovate, with a regularly curved outer margin. Parietal lamella low, erect. Columella narrowly triangular, unarmed. Peristome thin, erect. Umbilicus rather small, pyriform. Length 3.2, diam. 1.55, axis of apert. 1.1, par. lam. 0.05, umb. 0.29 mm.

Kahoolawe: Hakioawa (type loc., Pilsbry, Cooke), Hanakaea (Pilsbry), Ahupuiki and Kanapou (Forbes and Stokes). Type no. 36249 Bishop Museum, cotypes no. 111724 P. A. N. S.

An immature specimen, with nearly 5 whorls, has the apical whorls smooth, without a trace of spiral lines. The parietal lamella is low, erect, about 0.09 mm. in height. The columella is furnished with two low oblique folds, the upper of which is hardly visible (fig. 3).

This is the most abundant species of *Tornatellides* found on the island. It was present in all the fossil deposits. The only other species of this genus found there is referable to *T. macromphala* Anc. *Tornatellina gracilis* is also very abundant, and *Tornatellina baldwini* rather rare.

T. kahoolavensis undoubtedly belongs to the *proceralus* group. The upper columellar fold is a little more strongly developed than in most of the species. In size and form it approaches *T. irregularis* of West Maui. Probably *T. con-*

fusus is its nearest ally. It is, however, easily separated from that species by its larger size, more numerous whorls and stronger parietal lamella.

17. T. KONAENSIS C. & P., n. sp. Pl. 46, figs. 5, 6.

Shell umbilicate, narrowly ovately turrited, corneous, nearly smooth, slightly glossy, under a lens minutely striate with lines of growth, and with a few distant slightly stronger striæ on the median whorls, thin, translucent. Spire subconic, apex somewhat obtuse. Suture simple, well impressed. Whorls 6½, convex, the last rotund. Aperture narrowly oval, diagonal. Parietal lamella very minute, represented by a thin, raised line. Columella narrowly triangular, inner margin slightly arcuate. Peristome thin, erect, outer margin arcuate. Umbilicus large, circular. Length 3.8, diam. 1.8, axis of apert. 1.6, umb. 0.56 mm.

Hawaii: Kona (Baldwin); Puna (Spalding); Olaa (Thaanum). Type no. 36247 Bishop Museum, cotype no. 111725 P. A. N. S.

The original specimens of this species were received from Mr. Baldwin under the name *Tornatellina konaensis* Ancey, which has been retained, as Mr. Baldwin doubtless distributed other specimens under the same name. No specimens of this species are contained in the Ancey collection. Additional examples referable to *konaensis* were later collected by Spalding.

Mr. Thaanum found it in considerable quantity at Olaa. One of these specimens, in basal view, is drawn in fig. 6.

It differs from *T. procerulus* in the far wider umbilicus, the more lateral, oval aperture, and in having the parietal lamella reduced to a minute thread or even wholly lost in mature shells. In the neanic stage the lamella is distinct but very low. The species is closely related to *T. subangulatus*, but it is easily separated by its very low parietal lamella, form of aperture, etc.

In an immature specimen with five whorls, from Puna, the umbilicus is rather narrow and the columella slightly twisted. The parietal lamella is oblique, 0.13 mm. in height. The

lower columellar fold is deeply seated, 0.09 mm. in height and there is a slight swelling on the upper part of the columella, but no distinct upper fold. The embryonic whorls are smooth and there is no indication of spiral striæ.

18. T. SUBANGULATUS (Ancey). Pl. 46, figs. 9, 10.

"Shell oblong-conic, thin, rather shining, pale-corneous, pellucid, having inconspicuous growth-lines; openly umbilicate, the umbilicus cylindric, not very wide. Spire regularly conic, the apex rather small, somewhat obtuse. Whorls 6, a little convex, suture linear, the last whorl oblong, tapering and obscurely roundly-compressed, at the base, at the beginning more or less subangular. Aperture suboblique, narrowed at both ends, the parietal wall bearing a moderate spiral lamella. Columella somewhat swollen, unarmed, broadly dilated. Length 3, diam. 1.75, alt. apert. 1.33 mm." (*Ancey*).

East Maui: Kaupakalua (Baldwin), Kula (Cooke). Type no. 18449 Bishop Museum, paratypes no. 18608 Bishop Museum and no. 111846 P. A. N. S.

Tornatellina subangulata ANCEY, Journ. de Conchyl., li, 1903, p. 303, pl. 12, f. 15, 16.

"It differs from *T. peponum* [Ancey's *peponum* equals *procerula*] by the very regularly conic though quite long spire, the usually distinct angulation at the beginning of the last whorl, its tapering base, which narrows the aperture in this part, making it more or less angular; finally its umbilicus is well open and cylindric, though not reaching the size of that of *T. macromphala*, and is covered in a front view of the shell by a wide dilation of the columella. This is more or less swollen but constantly unarmed, even in the young stage" (*Ancey*).

A specimen from the Ancey coll. (no. 18608 Bishop Museum) with 6¼ whorls measures: length 3.3, diam. 1.75, axis of apert. 1.3, par. lam. 0.13, umb. 0.63 mm. This species appears to be very variable in the development of the columellar fold of immature specimens.

Very rarely the columellar fold is absent as stated by Ancey. Usually only the lower columellar fold is present, the

upper being always obsolete. In an immature specimen with 5 whorls, the parietal lamella is 0.16, the columellar fold 0.07 mm. in height. There are no spiral striæ on the embryonic whorls (fig. 10).

19. T. ONCOSPIRA C. & P., n. sp. Pl. 46, fig. 8.

Shell perforate, ovate, dark-corneous, glossy, minutely striate with lines of growth, somewhat thin and slightly transparent. Spire ovate, with convex outlines; apex obtuse, rounded. Suture simple, impressed. Whorls 5½, convex, the last rotund, subsaccate below. Aperture small, obliquely truncate-ovate. Parietal lamella well developed, oblique. Columella triangular, slightly concave below, furnished with a deeply-seated lower fold. Peristome thin, erect, outer margin convex. Umbilicus rather small, circular. Length 3.0, diam. 1.6, axis of apert. 1.2, par. lam. 0.22, umb. 0.27 mm.

Hawaii: Kaiwiki (Thaanum). Type no. 14170 Bishop Museum, cotypes in Thaanum coll.

A very rare species of which only four specimens have been taken. Unfortunately no immature specimens have been seen. A second specimen in the Bishop Museum has barely over 5 whorls. The parietal lamella is 0.18 mm. in height. The single basal columellar fold is slightly stronger than that of the type. The very convex outlines of the spire and the blunt apex easily separate this species from the others of the genus.

20. T. INORNATUS P. & C., n. sp. Pl. 46, fig. 13.

The shell is ovate-pyramidal, umbilicate, the axial perforation very small, but enlarged at the opening by the considerable deviation of the last whorl. Cinnamon, with some whitish lines and spots due to erosion. Glossy. Outlines of the spire straight, the apex obtuse. Whorls 6, not very convex, the last rounded basally. The aperture is irregularly ovate. Parietal lamella well developed, about one-third of a whorl long. Columellar margin broadly dilated, the columella vertical, unarmed.

Length 3.4, diam. 1.8, aperture 1.3 mm.

Molokai: Western ravine of Kamalo, near the old ditch trail (Cooke & Pilsbry).

More widely umbilicate than *T. procerulus,* with decidedly more strictly conic spire and a much larger parietal lamella. In the neanic stage there are two small, subequal, columellar lamellæ. It is less strictly conic than *T. subangulatus.* and has a smaller umbilicus.

Group of T. thaanumi.

Tornatellides with well-developed columellar folds in the adult stage. The shells are ovate-conic in outline; whorls convex. The columellar folds are parallel, oblique and extend nearly or quite to the margin of the columella.

This seems to be a natural and easily recognized group.

Key to the Species.

a. Shell less than 3 mm. in length, with a faint peripheral band; embryonic whorls faintly spirally striate.

b. Broadly conic, the diam. more than half the length. *T. thaanumi,* no. 21.

b[1]. Narrowly conic, the diam. about half the length. *T. diptyx,* no. 23.

a[1]. Shell more than 3 mm. in length, unicolorous; embryonic whorls not spirally striate. *T. idæ,* no. 22.

21. T. THAANUMI C. & P., n. sp. Pl. 47, figs. 1, 2, 4.

Shell perforate, broadly-ovate, brownish-corneous, with a faint, broad, lighter band at the periphery, dull, quite strongly striate for a *Tornatellides,* striæ minute, very close. Spire broadly conic, apex rounded, quite obtuse. Suture simple, well impressed. Whorls 6¼, quite convex, increasing very slowly and regularly, the embryonic slightly darker than the rest, the last rotund, subsaccate at the base. Aperture broadly ovate. Parietal lamella low, slightly oblique. Columella of the same color as the shell, straight, narrowly triangular, furnished with two rather low, oblique folds, both of which extend nearly to the margin of the columella. Peristome thin, erect, strongly arcuate. Length 2.75, diam. 1.65, axis of apert. 1.2, parietal lamella 0.13, umbilicus 0.22 mm. broad.

Molokai: Mapulehu (type loc.), Kaluaaha (Cooke); Waialua (Thaanum), Puunea (Pilsbry & Cooke). Type no. 36243 Bishop Museum, cotypes no. 111847 P. A. N. S. and in Thaanum coll.

In an immature specimen with 5½ whorls the embryonic whorls are minutely spirally striate, the parietal lamella is strong and oblique, 0.13 mm. in height. The columellar folds are not as strongly developed as usual and almost equal in size. The upper is 0.07 mm. in height (fig. 3).

It is one of the most distinct species of the genus, and the only one to show any color-pattern. Unfortunately an injudicious amount of potash was used in cleaning these shells and they have lost something of their original color.

In Mapulehu all the specimens were taken on the dead leaves of the Ti (*Cordyline terminalis*).

22. T. IDÆ C. & P., n. sp. Pl. 47, figs. 3, 5, 6.

Shell perforate, ovate, light-corneous, thin, transparent, shining, nearly smooth, under a lens minutely striate. Spire convexly conic, apex subacute. Suture simple, well impressed. Whorls 6½, convex, slowly increasing, compressed, the last tumid, subsaccate below. Aperture rather small, ovate. Parietal lamella of moderate size, oblique. Columella almost straight, simple, with two well-developed, oblique folds, both of which extend to the margin of the columella. Peristome thin, convex. Umbilicus small, circular, deep. Length 3.6, diam. 1.7, axis of apert. 1.2, par. lam. 0.18, umb. 0.14 mm.

Oahu: Palehua, in the Waianae Mts. (type loc., Cooke), Popowela, Makiki, Nuuanu, etc. (Spalding, Cooke). Type no. 14178 Bishop Museum, cotypes no. 111721 P. A. N. S. and Spalding coll.

T. idæ is widely spread on Oahu but it is rather rare, seldom are more than three of four specimens taken in a single day's collecting. It is terrestrial and is usually found on the dead leaves of the Ti (*Cordyline terminalis*). At first sight it might be taken for a small species of *Tornatellaria*, but it differs from that genus in being viviparous, and the embryonic whorls are not spirally striate.

From the other species of *Tornatellides* it is easily recognized by its strong, slightly oblique columellar folds. These folds are nearly equal in size, usually the upper is very slightly stronger than the lower. In the type specimen the lower fold is 0.09 mm. in height.

An immature specimen with over 5½ whorls has a rather strong, thick parietal lamella 0.2 mm. in height. The upper columellar fold is 0.13, the lower 0.2 mm. in height (fig. 4).

An embryonic specimen is minutely perforate; the upper 1½ whorls are smooth, the next whorl minutely transversely striate. Only the lower columellar fold is present. It is deeply seated and oblique. The parietal lamella is very strongly developed.

In the form from the western ridge of Popowela, which may be called var. *anisoplax* P. & C. (pl. 47, fig. 7), the lower columellar lamella is decidedly larger than the upper in fully adult specimens, as well as in the neanic stage. Type no. 108899 A. N. S. P., cotype in B. P. B. Mus.

23. T. DIPTYX P. & C., n. sp. Pl. 47, figs. 8, 9.

The shell is ovate-turrited, minutely umbilicate, brown, smooth; outlines of the spire straight, the apex obtuse. Whorls nearly 6, rather convex, the last short. Aperture small, ovate. *Parietal lamella very broad* and at least a half-whorl long. Columella bearing two horizontal lamellæ, the lower one somewhat more prominent. The lamellæ are rather deeply placed in the adult shell, but continue as low cords to the edge. In the neanic stage they are unequal and not immersed. Length 2.5, diam. 1.3 mm.

Molokai: Western ravine of Kamalo (Cooke & Pilsbry). Type no. 112532 A. N. S. P., cotype in B. P. B. Mus.

The base is abrupt, as in the *T. perkinsi* group. It is decidedly narrower than *T. thaanumi* and *T. idæ*.

Group of T. cyphostyla.

Tornatellides with elongate-conic spire and rather *flat whorls*. The base tapers. The parietal lamella remains of about the same height in adult and immature specimens, but

usually it is slightly stronger in the adult stage. The columella is usually unarmed in adult specimens. In immature specimens the columella is furnished with two oblique parallel lamellæ or folds, of which the lower is usually much stronger than the upper; the latter being situated high, close to the parietal wall.

This group is easily distinguished by its flat whorls. The form is more slender than is usual in the genus *Tornatellaria*.

a. Surface sculptured with irregular, low, rib-striæ.
T. insignis, no. 26.

*a*¹. Surface smooth.

b. Parietal lamella of adults moderately developed, more than 0.18 mm. in height.

c. Parietal lamella of adults more than 0.25 mm. in heights; shells with 7 or more whorls.

d. Adult shells more than 4 mm. in length.
T. attenuatus, no. 25.

*d*¹. Adult shells less than 3.3 mm. in length.
T. pilsbryi, no. 27.

*c*¹. Parietal lamella of adults less than 0.22 mm. in height, shells with less than 6½ whorls.
T. cyphostyla, no. 24.

*b*¹. Parietal lamella of adults very low, less than 0.1 mm. in height.

c. Length 2.9, diam. 1.5 mm. Oahu.
T. oahuensis, no. 28.

*c*¹. Length 4.6, diam. 2.2 mm. Molokai.
T. moomomiensis, no. 29.

24. T. CYPHOSTYLA (Ancey). Pl. 48, figs. 1, 2.

"Shell conoid-oblong, slender, smooth, white in the subfossil condition, thin, glossy, openly but minutely perforate. Spire conic, long, the sides straight, summit obtuse. Whorls 6, slightly convex, regularly increasing, separated by a linear, appressed suture, the last oblong, somewhat tapering. Aperture distinctly oblique, truncate-oval, armed with a single revolving parietal lamella. Columella regularly arcuate-sloping, somewhat thickened, unarmed. Peristome simple, acute,

unexpanded, the outer margin arcuate near the insertion, columellar margin expanded, hardly closing the perforation. In the young stage the columella is biplicate. Length 2.75, diam. 1.33, alt. apert. 1 mm." (*Ancey*).

Hawaii: Hamakua District; fossil (Henshaw). Type no. 18425 Bishop Museum, topotypes 36260 Bishop Museum and no. 111718 P. A. N. S.

Tornatellina cyphostyla ANCEY, Journ. of Malac., xi, 1904, p. 70, pl. 5, f. 22, 23.—HENSHAW, t. c., p. 64.

"A very distinct species, of regular outline. Its principal characters are the conic spire, barely convex whorls, appressed suture and oblong aperture not at all widened below and slightly oblique. The columellar margin is gently curved and without plicæ except in young specimens, and the parietal lamella is rather long" (*Ancey*).

This species is very abundant in the fossil earth from Hamakua. Unfortunately the margin of the peristome of the type specimen is slightly broken. A perfect specimen from the same lot of earth as Ancey's type measures: length 2.8, diam. 1.4, axis of apert. 1.1, par. lam. 0.2, umb. 0.27 mm. This specimen has 6⅓ whorls.

In an immature specimen with slightly over 5 whorls the columellar folds are very deeply seated and are not as strongly developed as in the other species of this group. The lower fold is 0.09 mm. in height and is much stronger than the upper, which forms a low, oblique fold close to the parietal wall. The parietal lamella is 0.18 mm. in height. The embryonic whorls are not spirally striate (fig. 2).

25. T. ATTENUATUS C. & P., n. sp. Pl. 48, figs. 3, 4.

Shell perforate, elongately conic, in the fossil state white, nearly smooth, under a strong lens minutely striate with lines of growth. Spire long and straightly conic; apex somewhat obtuse. Suture simple, scarcely impressed. Whorls 7½, *nearly flat*, the last elongate, tapering towards the base. Aperture small, oval. Parietal lamella strong, oblique. Columella unarmed. Peristome simple, erect, outer margin arcuate. Umbilicus small for a shell of this size, ovate. Length 4.2, diam. 1.9, axis of apert. 1.5, par. lam. 0.27, umb. 0.47 mm.

Oahu. Manoa, fossil (Cooke). Type no. 14134 Bishop Museum, cotypes no. 111714 P. A. N. S. Also Kaelepulu, Kailua (Pilsbry), and Laie, west of the stream, between the road and the sea, in a deposit of calcareous sand (Cooke and Pilsbry).

The appearance of this species is something like that of *T. cyphostyla* Anc. It is much larger, the whorls are slightly flatter, the aperture is broader in proportion to its length, etc. It resembles *T. insignis* in the shape and the minute axial perforation, enlarging at the last whorl; but it differs by the smoothness of the surface.

An immature specimen with 5½ whorls has the columellar folds deeply seated. The upper is low, transverse and indistinct, about 0.05 mm., the lower is parallel and 0.13 mm. in height. The parietal lamella is 0.21 mm. in height. In somewhat smaller neanic shells from Laie the columellar lamellæ are larger than in the example figured.

26. T. INSIGNIS P. & C., n. sp. Pl. 48, figs. 10, 11, 12, 13.

The shell is pyramidal, with moderate umbilicus, but an extremely small perforation of the axis. Spire straight-sided, the apex small but obtuse. Whorls 6½ to 7, the first convex, the rest *nearly flat*, the last whorl rounded below, its last half (more or less) flattened peripherally. *Sculpture of slightly irregular, low rib striæ*, strongest on the last whorl, diminishing upwards. The aperture is irregularly ovate; parietal lamella very wide, and fully a half-whorl long. Outer lip a trifle expanded. Columellar margin broadly dilated, unarmed. There is a low palatal callus, peripheral in position. Length 3.5, diam. 1.6, aperture 1.3 mm.

In the neanic stage there are two rather small, subequal, columellar lamellæ (fig. 12).

Oahu: fossil in shell-deposits on ledges of the "coral bluff," 1½ miles west of Kahuku (Cooke & Pilsbry). Type no. 112535 A. N. S. P., cotypes in B. P. B. Mus.

This shell stands nearest to *T. attenuatus*, a smooth species. The sculpture is much less emphatic than in *T. rudicostatus* of Hawaii, and the shape is quite different. Probably they

are not directly related, though they might be grouped together on account of the sculpture, which is stronger in these two species than in any other known *Tornatellinidæ*. Both species belong to the pleistocene fauna, and became extinct probably in the early human period.

27. T. PILSBRYI Cooke. Pl. 48, figs. 5, 6, 7.

Shell perforate, elongate-conic, corneous, glossy, under a lens minutely striate with growth-lines, thin, diaphanous, but rather strong. Spire elongate-conic, with *almost straight outlines*; apex slightly obtuse. Suture hardly impressed, margined with a broad line. Whorls nearly 7, the embryonic increasing rapidly, convex, minutely, indistinctly, spirally striate, the rest increasing slowly and regularly, nearly flat, the last whorl long, tapering towards the base. Aperture narrow, obliquely truncate-ovate. *Parietal lamella very large,* oblique. Columella dilated above, furnished with two weakly developed, oblique and deeply-seated folds, of which the lower is the stronger until the fully adult stage is reached. Peristome thin, erect, the outer margin regularly arcuate. Length 3.1, diam. 1.5, axis of apert. 1.1, par. lam. 0.29, umb. 0.3 mm.

Oahu: Western ridge of Popowela, in the Waianae Mountains (Cooke and Pilsbry). Type no. 36261 Bishop Museum, cotypes 111838 and 110764 P. A. N. S.

Tornatellides pilsbryi COOKE, Nautilus, xxviii, Nov., 1914, p. 79.

All the specimens collected by the junior author were on the trunks of a species of *Urera,* a foot or two above the ground. It was not abundant at the time, and a later visit to the exact spot did not yield a single specimen. The senior author obtained living specimens from the siftings of dead leaves, taken in the place where *Endodonta* is abundant.

This species is characterized by its very strong and unusually long parietal lamella which extends nearly a whorl inward. The columellar lamellæ are rather long, strong and oblique in the neanic stage, but nearly obsolete in the completely adult shell.

In an immature specimen with 5½ whorls the parietal la-

mella is 0.27 mm. in height. The lower columellar lamella is 0.2, the upper 0.14 mm. in height. Throughout the neanic stage the lower columellar lamella is much larger than the upper (fig. 5).

28. T. OAHUENSIS C. & P., n. sp. Pl. 48, figs. 8, 9.

Shell perforate, subconic, dark-corneous, somewhat glossy, under a strong lens minutely striate with lines of growth, somewhat solid, not diaphanous. Spire subconic, with narrowly ovate outlines; apex somewhat obtuse. Suture simple, slightly impressed. Whorls 6, slightly convex, the last ovate, slightly attenuate at the base. Aperture obliquely truncate-ovate. Parietal lamella small, slightly oblique. Columella narrowly triangular, unarmed. Peristome simple, erect, outer margin slightly arcuate. Umbilicus small, circular. Length 2.9, diam. 1.5, axis of apert. 1.0, par. lam. 0.08, umb. 0.28 mm.

Oahu: Kahuku, at a low elevation, on shrubs (Henshaw). Type no. 14133 Bishop Museum, cotypes no. 111836 P. A. N. S.

Unfortunately all of the material had been preserved in formalin and is somewhat bleached. This species is certainly closely related to *T. cyphostyla* Anc. The outlines of the spire are slightly more convex and the parietal lamella is much lower.

In an immature shell with 5½ whorls the periphery is slightly angled, but there is no sign of columellar folds. A slightly smaller specimen with 5 whorls has rather weak columellar folds. The lower is 0.11 and the upper 0.04 mm. in height. The parietal lamella is remarkably low for such a young specimen of this group, being only 0.11 mm. in height. In another immature specimen with 4 whorls the embryonic whorls are faintly and closely spirally striate (fig. 9).

29. T. MOOMOMIENSIS P. & C., n. sp. Pl. 48, figs. 14, 15.

The shell is pyramidal, openly umbilicate, very lightly striate. Spire with straight outlines, the apex subacute. Whorls 7, the first convex, the rest nearly flat. Last whorl tapering a

little below the periphery, narrowly rounded basally. The aperture is small, oblong. Parietal lamella reduced to a mere thread. Columella unarmed, its margin dilated. Umbilicus large, contracting slowly within. Length 4.6, diam. 2.2, length of aperture 1.5 mm.

Molokai: Moomomi, at base of the bluff and up to about 600 ft.; also back of the dunes, about a quarter of a mile inland; fossil in the calcareous sands (Cooke & Pilsbry). Type no. 112534 A. N. S. P., cotypes in B. P. B. Mus.

This species has the straight contour and flat whorls of the *T. cyphostyla* group and of *Tornatellaria*. It is distinguished by the extreme reduction of the parietal lamella, and the absence of columellar lamellæ, from at least the mid-neanic stage on. Whether these lamellæ are present in younger stages has not been ascertained.

Group of T. perkinsi.

Tornatellides with abrupt, almost truncate basal contour (though the base itself is convex), conical spire and closely coiled whorls. The parietal lamella of adults is usually very low, not over 0.1 mm. in height; in immature specimens it varies from nearly twice to three times the height of the lamella of adults. The columella is furnished with two nearly equal, almost transverse folds, which are visible through the umbilical wall and are not strong in the adult stage. In immature specimens the lower columellar fold is somewhat stronger than the upper. In most of the species the umbilicus is remarkably large, but in *perkinsi*, *frit* and *micromphala* it is small.

a. Umbilicus large, more than 0.5 mm. in diameter.

b. Adult shells with the diameter less than 57% of the length.

c. Adult shells not over 3.3 mm. in length and with less than 7¼ whorls.

T. macromphala, no. 34.

*c*¹. Adult shells more than 3.5 mm. (usually about 4 mm.) in length and with more than 7½ whorls. *T. productus*, no. 33.

b^1. Adult shells with the diameter more than 65% of the length. *T. spaldingi*, no. 36.

a^1. Umbilicus about 0.4 mm. diam.; shell 2.6 x 1.4 mm., broader than *T. perkinsi*. *T. comes*, no. 31.

a^2. Umbilicus rather small, less than 0.3 mm. in diameter.

b. Diameter more than half the length; 2.8 x 1.6 mm. *T. micromphala*, no. 35.

b^1. Diameter less than half the length.

c. Parietal lamella wide; whorls convex. *T. frit*, no. 32.

c^1. Parietal lamella low; whorls rather flat. *T. perkinsi*, no. 30.

30. T. PERKINSI (Sykes). Pl. 49, figs. 1, 2, 5.

"Shell elongate-pyramidal, subperforate, corneous, striatulate under the lens. Whorls 7, rather flat, slowly increasing; suture somewhat impressed. Aperture ovate, bearing a rather minute lamella on the parietal wall. Columella thickened, whitish, marked with two inconspicuous plicæ. Length 3, diam. 1.2 mm." (*Sykes*).

Kauai: Kaholuamano, at 4,000 ft. (Perkins), Olokele, Lihue (Cooke).

Tornatellina perkinsi SYKES, Fauna Hawaiiensis, ii, Mollusca, p. 382, pl. 2, f. 14 (1900).

"Its most noteworthy features are the very elongately pyramidal shape, flattened whorls, and the two inconspicuous plicæ on the columella, the upper one being more deeply seated than the lower" (*Sykes*).

The shells from Olokele were found on the fronds of *Polypodium spectrum* and are slightly smaller than the type specimen. One of them when compared with the type agreed perfectly except in size. It has 7 whorls and measures: length 2.9, diam. 1.2, axis of apert. 0.85, par. lam. 0.065, umb. 0.27 mm. The columella is tumid above and its folds are low and nearly transverse. The suture is distinctly margined. The embryonic whorls are rather smooth, except in specimens from Lihue which have the embryonic whorls regularly and minutely transversely striate.

In an immature specimen from Olokele with 5 whorls the shell is obliquely angulate at the periphery; the columella is furnished with two almost transverse, rather strong white folds, of which the lower is slightly stronger than the upper. The parietal lamella is strong and oblique, about 0.18 mm. in height. The upper columellar fold is 0.06, the lower 0.12 mm. in height (fig. 2).

30*a*. T. PERKINSI ACICULA n. subsp. Pl. 49, figs. 3, 4.

Specimens from Oahu, Molokai, Lanai and West Maui differ somewhat from the typical form of Kauai. Their spires are more slender and their apices decidedly more acute. The parietal lamella is, also, slightly stronger. This subspecies is rather widely distributed on the four islands but is never abundant in any one locality. Most of the specimens were taken on the dead leaves of *Pandanus* or ieie (*Freycinctia arnotti*). A specimen from Punaluu, Oahu, is selected for the type of this subspecies. It measures: length 3.0, diam. 1.3, axis of apert. 0.8, par. lam. 0.09, umb. 0.23 mm. and has 7¼ whorls. Most of the adult specimens from this locality have the front of the parietal lamella irregularly eroded. This feature has not been found in any specimens from other localities. It occurs also in Nuuanu (Glen Ada) and on Mt. Tantalus.

In an immature specimen with 5¾ whorls the parietal lamella is 0.21 mm. in height. It is indistinctly striate, the striæ being nearly parallel with its base. The upper columellar fold is 0.09, the lower 0.13 mm. in height. Its embryonic whorls are not spirally striate.

An embryonic shell from Waimea, Oahu, is minutely perforate. The first whorl is minutely spirally striate, the second faintly transversely striate. The parietal lamella is well developed and the columella is furnished with a rather strong basal fold (fig. 3). Types in B. P. B. Mus., cotypes no. 111, 839 A. N. S. P.

31. T. COMES P. & C., n. sp. Pl. 49, figs. 7, 8.

The shell is pyramidal, umbilicate (the axial perforation

very small, suddenly enlarging at the last whorl); brown, glossy. Outlines of the spire straight, the apex not very obtuse. Whorls 6, moderately convex, the last one short, rounded below. The aperture is short and rather broad. Parietal lamella well developed, nearly a half-whorl long. Columellar margin dilated. Columella vertical, bearing a *very weak* upper lamella, which extends nearly to the edge of the columellar lip. Length 2.6, diam. 1.4 mm.

Molokai: Western ravine of Kamalo, near the old ditch trail (Cooke & Pilsbry). Type no. 112537 A. N. S. P., cotypes in B. P. B. Mus.

Related to *T. perkinsi*, but less lengthened, with the whorls more convex. It is more conic than *T. frit*.

32. T. FRIT P. & C., n. sp. Pl. 49, fig. 6.

The shell is oblong-turrited, very narrowly umbilicate, brownish. Apex obtuse. Whorls 6, convex, the penultimate slightly prominent, last whorl short. Aperture short. Parietal lamella moderate, about one-third of a whorl long. Columella dilated, bearing a very low upper lamella, which continues inconspicuously to the edge. Length 2.9, diam. 1.3 mm.

Molokai: Western ravine of Kamalo (Pilsbry & Cooke). Type no. 109949 A. N. S. P., cotype in B. P. B. Mus.

This species is somewhat more slender than *T. perkinsi*, with less straightly conic spire, decidedly more convex whorls and slightly coarser striation. The umbilicus is a trifle smaller than in *T. perkinsi*, and smaller than in *T. comes*. The parietal lamella is broader than in either.

33. T. PRODUCTUS (Anccy). Pl. 49, figs. 9, 10, 11.

Shell narrowly umbilicate, elongate, conic, subtruncate at the base, corneous, glossy, nearly smooth, microscopically striate with growth-lines, quite thin, subdiaphanous. Spire elongate-conic, apex somewhat acute. Suture simple, slightly impressed. Whorls 8, hardly convex, very slowly and regularly increasing, the last short, rotund, subtruncate and saccate at the base. Aperture elongate-oval, somewhat obliquely truncate above. Parietal lamella minute. Columella

scarcely tumid, narrowly triangular, furnished with two minute scarcely oblique folds, the lower being weaker than the upper. Peristome simple, erect, outer margin arcuate, columellar margin nearly straight. Umbilicus nearly circular. Length 4, diam. 1.8, axis of apert. 1.2, par. lam. 0.07, umb. 0.54 mm.

Kauai: Kipu (Baldwin, Cooke), Nounou Mts. (C. S. Dole), Hanakapiai (Deverill), Lihue, Hanakoa, Kalalau, Halemano, Makaweli (Cooke).

Tornatellina macromphala var. *producta* Anc., Journ. de Conchyl., li, 1903, p. 297.

Ancey's material consisted of two specimens both of which are much discolored. *Productus* differs from *macromphala* by its much more slender spire, straighter outlines, number of whorls, etc. Both species often occur together but in such cases there are no intermediates. It is a rather common species up to about 3,000 ft. elevation, and is usually found on the dead leaves of *Pandanus,* sometimes in very open country. They also differ in the color of the animals. In *macromphala* the animal is very dark, while that of *producta* is very light.

An extremely narrow form has been found at Kipu. An adult specimen with slightly more than 7 whorls measures: length 3.2, diam. 1.3. This form seems at first sight to be more closely related to *T. perkinsi,* but the more acute apex, color, and wider umbilicus place it with *productus.*

In an immature specimen of the typical form, with 5½ whorls, the apical whorls are minutely spirally striate. The last whorl is angulate at the periphery. The parietal lamella is 0.12 mm. in height. The columella is furnished with two slightly oblique folds, the upper 0.08, the lower 0.1 mm. in height (fig. 10).

34. T. macromphala (Ancey). Pl. 49, figs. 14, 15, 16.

"Shell conic-turbinate, thin, corneous, slightly shining, openly and deeply umbilicate, the umbilicus large for the genus, circular; delicately marked with growth-lines. Spire produced, of perfectly conic outlines, the apex minute.

Whorls 6 to 6¼, slowly and regularly increasing, a trifle convex, parted by a simple suture, the last whorl short, dilated, saccate, hardly angular. Aperture short, small, nearly vertical, obliquely truncate above; furnished with a small or moderately small parietal lamella. Columella tumid, bearing two spiral lamellæ (visible in the young stage, but in adults more or less obsolete, especially the lower one which is sometimes almost entirely absent). Peristome simple, the columellar margin dilated, expanded. Length 2.75, diam. 1.75, alt. apert. 1 mm." (*Ancey*).

East Maui: Kaupakalua (type loc.) and Keanae. Oahu: Tantalus (Baldwin). Molokai and Kahoolawe (Cooke & Pilsbry). All islands except Niihau. Cotypes no. 18439 Bishop Museum, topotypes no. 111834 P. A. N. S.

Tornatellina macromphala Anc., Journ. de Conchyl., li, 1903, p. 296, pl. 12, f. 3, 4.—Henshaw and Ancey, Journ. of Malacology, xi, 1904, pp. 63, 70.

"This species is remarkable, when completely developed, for the swollen base and the amplitude of the umbilicus. Young shells are more narrowly perforate and have readily visible though small columellar lamellæ, which are feeble or nearly disappear in the adult" (*Ancey*).

The shells from the different islands are remarkably alike and the species is very common and generally distributed. Ancey's specimens from Keanæ, East Maui, do not seem to have passed into the collection of the Bishop Museum, although there are other species of *Tornatellides* from this locality. The type specimen of this species was not isolated by Ancey in his collection, in which there is but a single lot of six specimens labeled in his handwriting. This lot is undoubtedly the type lot, and is from Kaupakalua, East Maui. There are, besides this type lot, eighteen other lots of this species from Maui in the Ancey collection, none of which were labeled, except as to locality.

Most of the specimens of the type series are larger than the measurements given in the description. The specimen which best fits the description has 6½ whorls and measures: length 2.9, diam. 1.6, axis of apert. 1, par. lam. 0.09, umb. 0.5 mm.

One of the larger specimens has 7 whorls and measures: length 3.2, diam. 1.8, axis of apert. 1, par. lam. 0.09, umb. 0.63 mm. Another lot from the Ancey collection has a number of immature specimens. One of them, with 5⅓ whorls, has the apical whorls nearly smooth. The columella is furnished with two strong almost transverse nearly equal folds of which the upper is 0.09, the lower 0.13 mm. in height. The parietal lamella is oblique, 0.18 mm. in height.

In an embryonic shell, from Nuuanu, Oahu, the first whorl is irregularly spirally striate, the second faintly and irregularly clathratulate. There is a minute perforation. The columella is straight. The lower columellar fold is present, the upper is merely indicated by a faint swelling on the inner margin of the columella. The parietal lamella is well developed and slightly oblique (fig. 16).

T. macromphala is common in pleistocene or later deposits on several islands. One from the bluff west of Kahuku, Oahu, measures, length 3.2, diam. 2 mm.

34*a*. *T. m. ada* P. & C., n. subsp. Pl. 49, figs. 17, 18.

The shell is slightly smaller than *T. macromphala* from which it differs chiefly by having a conspicuously smaller umbilicus, both within and at the opening; but it is, however, decidedly larger within than in *T. micromphala*. There are two distinct though small columellar lamellæ. Length 2.6, diam. 1.55 mm. Whorls 6.

Oahu: Glen Ada, north side of Nuuanu Valley (Pilsbry). Type no. 112538 A. N. S. P., cotype in B. P. B. Mus.

35. T. MICROMPHALA P. & C., n. sp. Pl. 49, figs. 12, 13.

The shell is conic, somewhat like *T. macromphala*, but narrower, with the whorls more convex. Umbilicus much narrower both within and at the opening; the wall bounding the umbilicus is convex, not flattened as in *macromphala*. Parietal lamella low but rather long. Two weak and subhorizontal columellar lamellæ, continuing to the edge. Length 2.8, diam. 1.6 mm.; umbilicus 0.3 mm. Whorls 6.

Molokai: Western ravine of Kamalo (Cooke & Pilsbry). Type no. 112536 A. N. S. P., cotypes in B. P. B. Mus.

The columellar lamellæ are strong and subequal in the neanic stage. *T. plagioptyx* is a larger species, with the base more produced and the columellar lamellæ more oblique.

36. T. SPALDINGI C. & P., n. sp. Pl. 53, figs. 6, 7, 8.

Shell openly perforate, conic, corneous slightly glossy, under a lens minutely striate with growth-lines, rather thin, subdiaphanous. Spire broadly conic, with almost straight outlines, apex rather acute. Suture simple, impressed. Whorls 6, rather closely coiled, slightly convex, the last large, rotund, saccate, with flattened base. Aperture rather small, broadly auriform. Parietal lamella minute. Columella tumid above, concave below, with two minute almost horizontal folds. Peristome simple, erect, outer margin arcuate. Umbilicus large, circular. Length 2.4, diam. 1.6, axis of apert. 0.9, par. lam. 0.08, umb. 0.74 mm.

Oahu: Kaaawa, type loc., on dead Pandanus leaves (Spalding), Ahuimanu (Spalding), ? Leilehua in the Waianæ Mts. (Cooke). Type no. 36259 Bishop Museum, cotypes no. 111845, P. A. N. S. and Spalding coll.

Closely related to *T. macromphala,* but shorter, wider in proportion to its length and, in the typical form, with a decidedly wider umbilicus.

An immature specimen with 4⅔ whorls has the columella furnished with two rather strong, nearly equal folds, the upper is 0.11, the lower 0.13 mm. in height. The parietal lamella is strong, oblique, 0.14 mm. in height. The first embryonic whorl is minutely spirally striate, the second nearly smooth (fig. 8).

Specimens from Leilehua are doubtfully placed in this species. The shells have approximately the same measurements as the typical form, but the umbilicus is much less in diameter.

Group of T. euryomphala.

Tornatellides with turrited spires, convex whorls, of a brownish corneous color, and with a slightly shortened base in most species. Usually the columella is furnished with one or

two lamellæ or folds. In adult specimens the upper columellar lamella is the stronger; sometimes the lower or both lamellæ are obsolete. The opposite occurs in immature specimens, as the lower lamella is usually much stronger than the upper, sometimes extending horizontally for about ⅓ the diameter of the aperture. The umbilicus is rather small, oval in outline. In immature specimens the parietal lamella is much stronger than in adults. The embryonic whorls may be spirally striated or not.

This is one of the most numerous groups in species and varieties. It differs from the Group of *T. simplex* by having *two distinctly developed columellar lamellæ in the neanic stage.* These may persist in the adult stage in some species; in others they are more or less receding or immersed, or none may be visible in the adult, which by itself might cause such species to be placed in the *simplex* group.

a. Adult shells with the parietal lamella less than 0.05 mm. in height; columella unarmed; 2.1 x 1.1 mm.
T. leptospira, no. 48.

*a*¹. Adult shells with the parietal lamella more than 0.1 mm. in height.

b. Adult shells less than 3.1 mm. in length.

c. Whorls very closely coiled; 6 or more whorls.

d. Umbilicus rather small, but more than 0.24 mm. in diameter.

e. Adult shells less than 2.7 mm. in length.

f. Adult shells with the diameter less than 52% of the length.
T. brunneus, no. 43.

*f*¹. Adult shells with the diameter less than 48% of the length.
T. pyramidatus, no. 41.

*e*¹. Adult shells 2.9 mm. or more in length.

f. Light brown; upper columellar lamella conspicuously emerging in adults.

T. euryomphala, no. 37.

f^1. Darker; columellar lamellæ not visible in a front view.

T. waianaensis, no. 42.

d^1. Umbilicus minute, less than 0.15 mm. in diameter. *T. macroptychia*, no. 44.

c^1. Whorls loosely coiled, not more than 5¾.

d. Shells more than 2.7 mm. in length.

e. Last whorl broadly ovate, aperture long, rather narrow; 2 columellar lamellæ emerging. *T. bellus*, no. 46.

e^1. Columellar lamellæ receding, not visible in a front view of the adult; 3.3 x 1.8 mm., with 5½ whorls.

T. popouelensis, no. 40.

d^1. Shells less than 2.5 mm. in length, last whorl ovate, aperture truncate-ovate, rather broad. *T. virgula*, no. 45.

b^1. Adult shells over 3.2 mm. long.

c. Columella showing two lamellæ in the adult stage, front view.

d. 3.8 x 1.65 mm., 7 whorls.

T. ronaldi, no. 39.

d^1. 3.4 x 1.9 mm., 5¾ whorls.

T. plagioptyx, no. 47.

c^1. Columella unarmed or with scarcely noticeable lamellæ in front view of adults.

d. Spire a little convexly conic; 3.7 x 1.65 mm., 7 whorls; crest of parietal lamella uneven. *T. irregularis*, no. 38

d^1. Spire conic; 3.3 x 1.8 mm., 5½ whorls.

T. popouelensis, no. 40.

37. T. EURYOMPHALA (Ancey). Pl. 50, figs. 1, 2, 3.

"Shell turrite, thin, corneous, a little shining, fulvous-corneous, having, for the genus, a broad, open and deep umbilicus. Spire conic, rectilinear. Whorls 6, convex, striatulate, regularly increasing, suture impressed, the last whorl rounded,

more ample, wider. Aperture suboblique, emarginate, with a strong revolving lamella on the belly of the penultimate whorl and two obsolete columellar denticles, the lower one smaller. Peristome simple, acute, the upper margin arcuate, columellar margin dilated, expanded. Length 3, diam. ½, length of apert. 1, width scarcely 1 mm." (*Ancey*).

West Maui: highest point; Lahaina (Baldwin). Type no. 18430 Bishop Museum, paratypes no. 18431 and 18432 Bishop Museum and no. 111719 P. A. N. S.

Tornatellina euryomphala Anc., Bull. Soc. Malac. France, vi, 1889, p. 239.—Sykes, Faun. Haw., ii, p. 381.

"Differs from *newcombi* by its smaller size, the number of whorls, width of the umbilicus, strong parietal lamella, and the slightly projecting, obsolete, columellar denticulations" (*Ancey*).

Ancey's type material consists of three specimens. A single adult and two immature, one of which is nearly adult. There is a second lot of six specimens from Lahaina collected by Baldwin and named by Ancey. One of these is almost the duplicate of the type and is in far better condition. This specimen (pl. 50, figs. 1, 2) has 6½ whorls and measures: length 3, diam. 1.5, axis of apert. 1.05, par. lam. 0.16, umb. 0.36 mm. Ancey's type measures 1.5 mm. in diameter, not one-half mm., as stated in his description.

T. euryomphala and *T. macroptychia* are very closely related. The former is slightly larger, with more convex whorls, the base is flatter and the umbilicus is larger. In adult specimens the upper columella fold is stronger than the lower. The surface is minutely striate.

An immature specimen, from the same lot as the figured specimen, is much lighter in color. It has 5¼ whorls, the lower columellar fold is much stronger than the upper, the former being 0.12, the latter 0.05 mm. in height. The parietal lamella is 0.2 mm. in height. It is eccentrically ribbed with 3-4 raised lines, one of which forms the inner margin of the lamella. The embryonic whorls are not spirally striate (fig. 3).

38. T. IRREGULARIS C. & P., n. sp. Pl. 50, figs. 4, 5, 6.

Shell narrowly umbilicate, narrowly ovate, brownish-corneous, shining, somewhat diaphanous, minutely striate with lines of growth. Spire ovately conic, apex subobtuse. Suture lightly impressed, faintly margined and minutely crenulate. Whorls 7, the embryonic increasing rapidly, the rest slightly convex, increasing very slowly and regularly, the last rotund, subtruncate at the base and slightly saccate. Aperture small, ovate, obliquely truncate. Parietal lamella of medium height, slightly oblique, in adult or nearly adult specimens the front is irregularly eroded. Columella swollen above, concave below, unarmed. Peristome thin, erect, with the outer margin quite convex. Length 3.7, diam. 1.65, axis of apert. 1.25, par. lam. 0.16, umb. 0.35 mm.

West Maui: Top of Mt. Kukui at about 6,000 ft. elevation. Quite abundant on the leaves of shrubs (Cooke). Type no. 14157 Bishop Museum, cotypes no. 111723 P. A. N. S.

This species is undoubtedly closely related to *T. euryomphala* but differs in its more cylindrical form, flatter whorls, narrower last whorl, etc. In some cases the erosion has destroyed most of the parietal lamella, the remaining portion assuming the most fantastic forms. In young specimens only the front portion of the large oblique parietal lamella is eroded.

In an immature specimen with 4½ whorls the parietal lamella is 0.23 mm. in height, there is a single deep cleft just back of its outer extremity. The upper columellar fold is 0.11, the lower 0.18 mm. in height. In older, but not adult specimens, there are from 3 to 5 deep clefts in the parietal lamella (fig. 5).

39. T. RONALDI C. & P., n. sp. Pl. 50, figs. 7, 8.

Shell perforate, elongately turrited, brownish, with lighter colored embryonic whorls, surface silky, slightly glossy, under a lens minutely striate, striæ rather stronger than in most *Tornatellides*, flexuous; rather thin, somewhat diaphanous. Spire elongately turrited, with rather straight outlines; apex acute. Suture impressed, with its margin minutely irregu-

larly crenulate. Whorls 7, the embryonic increasing rapidly, the rest convex, increasing slowly, the last elongate, tapering towards the base, slightly flattened about the umbilicus. Aperture rather large, obliquely truncate-oval. Parietal lamella moderate. Columella narrowly triangular, furnished with two minute parallel folds, which extend to the margin. Peristome thin, erect, with the outer margin slightly flattened. Length 3.8, diam. 1.65, axis of apert. 1.2, par. lam. 0.14, umb. 0.38 mm.

Oahu: Palehua in the Waianae Mts. (type loc.) and along the range as far as Popowela. Type no. 36267 Bishop Museum, cotypes no. 111844 P. A. N. S.

Named for Ronald von Holt, who collected a part of the original series. This species is found on the leaves and twigs of shrubs and on the ieie. *T. ronaldi* is separated from the other species of this group by its size, long attenuate spire and convex whorls. Its distinctly irregularly striated surface also serves to differentiate it.

In an immature specimen with 5 whorls the embryonic whorls are smooth, without an indication of spiral striæ. The parietal lamella is strong, oblique and 0.21 mm. in height. The lower columellar fold is strong, but not as strong proportionately as in most of the other species of this group. The upper columellar fold is 0.11, the lower 0.18 mm. in height (fig. 7).

40. T. POPOUELENSIS P. & C., n. sp. Pl. 50, figs. 9, 10. 11, 12.

The shell is pyramidal, umbilicate (the umbilicus moderately wide in the last whorl, but above it the axial perforation is very small), cinnamon-brown, somewhat glossy, finely, unevenly striatulate. The outline of the spire is straight, the apex rather obtuse. Whorls 5½, moderately convex, the last narrowly rounded at the base, and somewhat excavated behind the broad wall of the columellar lip. Aperture truncate-ovate. Parietal lamella moderate, nearly a half-whorl long. Columellar margin slightly sinuous, dilated. Columella having a quite small, deep-seated, oblique lamella close to its insertion, and the trace of another below it; neither reaching to

the edge of the dilated columellar lip. Length 3.4, diam. 1.9 mm.

Immature specimens have the parietal lamella stronger, and there are two oblique columellar lamellæ, the lower one slightly larger (fig. 9).

Oahu: Western ridge of Popouwela, in the Waianae Mountains at the "Endodonta locality" (Spalding, Cooke & Pilsbry). Types no. 108896 A. N. S. P., cotype in B. P. B. Mus.

T. ronaldi is a narrower, more lengthened shell, otherwise closely related to this species, which was found in abundance in the leaf-siftings. *T. popouelensis* is darker-colored than *Tornatellaria baldwiniana*, the umbilicus is more widely open, and it is viviparous.

41. T. PYRAMIDATUS (Ancey). Pl. 51, figs. 1, 2.

"Shell conoid-turrite, thin, glossy, of a pleasing rufous-corneous, openly but minutely umbilicate, under a lens slightly marked with growth-lines. Spire produced, long-conoid, the apex a little obtuse. Whorls 6½-7, slowly increasing, separated by an impressed, very horizontal suture, convex, the last whorl ovate, rather short, hardly dilated, tapering a little at the base. Aperture small, irregularly oval, obliquely subtruncate above, nearly vertical, armed with a moderate compressed parietal lamella. Columella swollen, dilated, unarmed or obsoletely one-folded above. Peristome simple, the columellar margin rather widely expanded. Length 2.66, diam. 1.25, alt. apert. scarcely 1 mm." (*Ancey*).

"In the young the columella is provided with two strong, acute lamellæ, the lower one larger" (*Ancey*).

Hawaii: Olaa (Thaanum, Cooke), Hilo (Thaanum), Kilauea (Cooke). Type no. 18444, cotypes no. 18646 Bishop Museum.

Tornatellina pyramidata ANC., Journ. de Conchyl., li, 1903, p. 304, pl. 12, f. 19, 20.

"I see no species with which I could unite *T. pyramidata*, a small, long shell recalling *T. cylindrica* Sykes and *gracilis* Pease in general shape, though the spire is more regularly pyramidal and conic. The parietal lamella is moderately

strong, and the columellar dilation, slightly swollen in the adult, carries an indistinct fold above, tending to be obsolete. In young shells, on the contrary, two strong columellar folds may be observed, the lower one projecting more. The coloration is a very light reddish-corneous'' (*Ancey*).

Ancey's type-specimen is broken about the parietal wall and does not show the characters of the aperture. A second lot from the Ancey collection, from Hilo, has three specimens, one of which is immature. This is undoubtedly the young specimen referred to by Ancey in his note.

Typical specimens were collected in Olaa. In an adult specimen (pl. 51, fig. 1) the columella is furnished with two low, indistinct folds. This specimen measures: length 2.6, diam. 1.25, axis of apert. 0.92, par. lam. 0.14, umb. 0.25 mm. *T. pyramidatus* is very closely related to *T. macroptychia* of East Maui. It differs mainly in its slightly more convex and closely-coiled whorls, shorter last whorl and, in adult specimens, the columellar folds are less strongly developed.

In a young specimen with 5 whorls the lower columellar fold is not as strongly developed as in the young of *T. macroptychia* of about the same age. The upper fold is 0.02, the lower 0.09 mm. in height. The parietal lamella is 0.22 mm. in height (pl. 51, fig. 2).

An embryonic shell from Kilauea is nearly smooth, there are no indications of spiral lines, but the surface is minutely transversely striate, especially near the suture.

42. T. WAIANAENSIS P. & C., n. sp. Pl. 51, figs. 3, 4.

The shell is slender, turrited, umbilicate (the umbilicus moderately large at the last whorl, but the axial perforation above it very minute); cinnamon-brown, usually showing darker and paler streaks; somewhat shining; distinctly striate at and below the periphery. Outlines of the spire straight. Whorls 6½, convex. Parietal lamella high and at least a half-whorl long. Columellar lip broadly dilated, and having the very weak, inconspicuous trace of a lamella, which is subhorizontal and close to the upper insertion. Length 3.2, diam. 1.45, aperture 1 mm.

In the metaneanic substage there are two high columellar lamellæ, the lower one somewhat the stronger and a somewhat diffuse entering callous ridge, lower palatal in position, much as in some young Auriculellas. The columellar lamellæ persist in the paraneanic substage, but the palatal ridge gradually disappears (fig. 4).

Oahu: Western ridge of Popouwela, Waianae Mountains, in the "*Endodonta* locality" (Spalding, Cooke & Pilsbry). Types no. 108894 A. N. S. P., cotypes in B. P. B. Mus.

This species, like nearly all the Popouwela forms, was taken in abundance. The last whorl is less shortened and less abruptly terminated below than in any form of *T. perkinsi*. The color is darker, and the parietal lamella larger. The palatal callus of the young shell is a remarkable feature.

Ordinarily one cannot see distinct columellar lamellæ within the aperture of adults, in oblique view; but one specimen of full size and appearing to be adult (pl. 51, fig. 7) shows them well developed far within, though not visible in a direct front view. Possibly we have to do with another species, but it may be a case of individual retention of a feature of immaturity.

43. T. BRUNNEUS C. & P., n. sp. Pl. 51, figs. 5, 6.

Shell perforate, narrowly ovately-turrited, reddish-brown, embryonic whorls corneous, somewhat glossy, nearly smooth, under a lens minutely striated, quite thin, subdiaphanous. Spire turrited, apex somewhat acute. Suture simple, impressed. Whorls 6, convex, slowly and regularly increasing, the last rotund, with somewhat saccate base. Aperture broadly ovate. Parietal lamella well developed, slightly oblique. Columella tumid above, furnished with a single minute, almost transverse fold just below the parietal wall. Peristome simple, erect, outer margin convex. Umbilicus minute, oval. Length 2.45, diam. 1.3, axis of apert. 0.95, par. lam. 0.14, umb. 0.3 mm.

Oahu: Nuuanu near the Pali, on the leaves of a grass (*Agrostis variabilis*). Type no. 36266 Bishop Museum, cotypes no. 111715 P. A. N. S.

In this species usually only the upper columellar fold is present in adult specimens. Sometimes the lower fold is represented by a faint raised line. *T. brunneus* is more nearly related to *T. macroptychia* than to any other species of the group. It differs slightly in size, less tapering base, etc.

In an immature specimen, with slightly more than 5 whorls, the parietal lamella is large, slightly oblique, 0.23 mm. in height. The columellar folds are strong, and nearly equal in size. The upper is 0.16, the lower 0.18 mm. in height (fig. 5).

In an embryonic specimen the shell is minutely perforate and the surface is smooth, there being no indications of spiral lines.

44. T. MACROPTYCHIA (Ancey). Pl. 51, figs. 8, 9.

Shell perforate, narrowly conic, brownish-corneous, with a silky surface, minutely striate with lines of growth, thin, slightly diaphanous. Spire narrowly conic, apex obtuse. Suture impressed, minutely crenulate, indistinctly narrowly margined. Whorls 6, the embryonic increasing rather rapidly, the rest closely coiled, increasing slowly, convex, the last oblong, tapering towards the base. Aperture truncate-ovate. Parietal lamella moderate. Columella narrowly triangular, furnished with two nearly equal, oblique folds, of which the upper is slightly stronger. Peristome thin, erect, the outer margin regularly curved. Umbilicus minute, circular. Length 2.8, diam. 1.4, axis of apert, 1.0, par. lam. 0.12, umb. 0.14 mm.

East Maui: Kaupakalua (Baldwin), Ukulele (Forbes). Type (immature) no. 18437 Bishop Museum, paratype (adult) 36262 Bishop Museum. Cotypes no. 111835 P. A. N. S.

Tornatellina macroptychia ANCEY, Journ. de Conchyl., li, 1903, p. 305, pl. 12, f. 21, 22.

Unfortunately the material from which Ancey described this species was not adult. Adult specimens occur in the Ancey collection in two unassorted lots, but were not recognized by him. The columellar folds persist in *T. macroptychia* longer than in most of the species of this group. *T. macrop-*

tychia is characterized by its small size, closely coiled whorls and rather obtuse apex. No embryonic specimens have been examined.

In the immature specimen of the type lot, the first embryonic whorl is slightly flattened. There are faint indications of spiral lines on the second whorl. The parietal lamella is 0.19 mm. in height. The upper columellar fold is 0.14, the lower 0.19 mm. in height (fig. 9). There are four specimens labeled as cotypes by Ancey in his collection, of which three belong to *T. virgula*.

The original description is as follows:

Tornatellina macroptychia Anc. "Shell conic-oval, fulvous-corneous, with a rather silky sheen, marked with close, microscopic lines of growth, very minutely perforate. Spire conic, nearly two-thirds the total length of the shell, the apex minute, obtuse. Whorls 5 to 5¼, convex, regularly increasing, suture impressed, the last whorl rather abruptly ovate, slightly tapering. Aperture suboblique, truncate-rounded, obstructed by strong white lamellæ as follows: one very large revolving parietal, and two acutely produced, horizontal columellar lamellæ, the lower one larger. Peristome acute, narrowly expanded in triangular shape at the columella. Length 2, diam. 1.2, alt. apert. 0.75 mm.

"This small fulvous-corneous species is very peculiar. Its strong lamellæ are far more developed than in any Hawaiian *Tornatellina* whatever. For a moment I thought this the feature of a shell not yet adult (for in nearly all the species of this genus the lamellæ are stronger in the young than in the adult stage, when those of the columella disappear or become weaker) yet the number of whorls seems to indicate a contrary view; moreover it is impossible to relegate *T. macroptychia* to any species yet known in the archipelago. The parietal lamella is extremely large, and the two columellar lamellæ are very prominent and placed horizontally, the lower one being larger. The perforation is narrow and covered above by the expansion of the columellar margin" (*Ancey*).

45. T. VIRGULA C. & P., n. sp. Pl. 51, figs. 10, 14.

Shell minutely perforate, elongate, narrowly ovate, corneous, glossy, under a lens minutely striate with lines of growth, thin, diaphanous. Spire elongate, with slightly convex outlines. Suture simple, impressed. Whorls 5¾, slightly convex, the last ovate, somewhat tapering towards the base. Aperture obliquely truncate-ovate. Parietal lamella rather small, scarcely oblique. Columella narrowly triangular, furnished with two low thread-like folds. Peristome simple, erect, outer margin arcuate. Umbilicus minute, circular. Length 2.4, diam. 1.2, axis of apert. 1.0, par. lam. 0.11, umb. 0.25 mm.

East Maui: Kaupakalua (Baldwin). Type no. 36264 Bishop Museum, cotypes no. 111849 P. A. N. S.

This species closely resembles *T. macroptychia,* but is slightly smaller, with less conic spire and the whorls are not as closely coiled. The name appears in Ancey's collection and in specimens sent out by Baldwin, now in the Cooke collection. With Ancey's type of *T. macroptychia* were three of this species.

In an immature specimen with 4½ whorls, the last whorl in much narrower and tapers more towards the base than in *macroptychia* and the columellar folds are not as strongly developed. The first embryonic whorl is very minutely and faintly spirally striate. The parietal lamella is 0.21 mm. in height. The upper columellar fold is 0.09, the lower 0.18 mm. in height (fig. 10).

46. T. BELLUS C. & P., n. sp. Pl. 53, figs. 4, 5.

Shell minutely perforate, ovately conic, reddish-brown, with embryonic whorls corneous, very glossy, nearly smooth, under a strong lens minutely striate, thin, diaphanous. Spire ovately conic, apex somewhat obtuse. Suture simple, impressed. Whorls 5¾, convex, increasing regularly and slowly, the last broadly ovate, tapering towards the base. Aperture obliquely truncate-ovate, somewhat auriform. Parietal lamella moderate, hardly oblique. Columella narrowly triangular, slightly tumid above, furnished with two very acute and

oblique folds. Peristome simple, erect, outer margin convex, columellar margin somewhat reflexed over the narrow umbilicus. Umbilicus minute, circular. Length 2.8, diam. 1.5, axis of apert. 1.3, par. lam. 0.16, umb. 0.23 mm.

West Maui: Maunahooma near Lahaina (Cooke). Type no. 14113 Bishop Museum.

This species is closely related to *T. brunneus* of Oahu but the spire is broader with more convex outlines, the base is more attenuate and the whorls are more loosely coiled. From the other species from Maui *T. bellus* differs by its more attenuate base, long and narrow aperture, etc. The umbilicus is narrow and compressed. The measurement above is across the longer diameter. The columella, viewed from below, is flexuous. The two columellar folds extend nearly to the margin. There is only a single immature specimen in the series. It has slightly over 5 whorls. The parietal lamella is 0.2 mm. in height. The columellar folds are rather large and parallel. The upper is 0.12, the lower 0.16 mm. in height.

47. T. PLAGIOPTYX Pilsbry & Cooke, n. sp. Pl. 53, figs. 1, 2, 3.

The shell is ovate-pyramidal, umbilicate, the umbilicus moderate, but reduced to a perforation above the last whorl. Outlines of the spire straight, the apex obtuse. Whorls 5¾, rather strongly convex. Brown, with irregular white lines due to erosion of the cuticle. Parietal lamella moderate, nearly a half-whorl long. Columellar margin dilated. Columella bearing two small, equal, rather strongly oblique lamellæ, which do not reach the expanded edge in adult shells. Length 3.4, diam. 1.9, aperture 1.4 mm.

Molokai: Western ravine of Kamalo, near the old ditch trail (Cooke & Pilsbry). Type no. 112533 A. N. S. P., cotype in B. P. B. Mus.

This is a larger, broader shell than *T. euryomphala* or *T. macroptychia*, with the parietal lamella lower and the columellar folds more slender. In the immature stages they reach to the margin of the columellar lip. It is a more robust shell than *T. bellus*, with more convex whorls; but the two are closely related.

48. T. LEPTOSPIRA C. & P., n. sp. Pl. 51, figs. 11, 12, 13.

Shell perforate, narrowly elongate-ovate, brownish-corneous, glossy, under a lens very minutely striate, thin, translucent. Spire narrowly turrited, with slightly convex outlines, apex blunt. Suture slightly impressed, simple. Whorls 5½, the embryonic increasing very rapidly, the rest increasing slowly and regularly, convex, the last slightly swollen, obliquely truncate at the base. Aperture rather large, auriform. Parietal lamella low. Columella unarmed, narrow. Peristome thin, erect, with its outer margin regularly curved. Umbilicus rather large. Length 2.1, diam. 1.1, axis of apert. 0.85, par. lam. 0.03, umb. 0.3 mm.

Oahu: Nuuanu near the Pali, on the stems of a grass (*Agrostis variabilis*). Type no. 36268 Bishop Museum, cotypes no. 111833 P. A. N. S.

Most nearly related to *T. virgula* of East Maui. From this species it differs in size, fewer whorls, smaller parietal lamella, etc. It is undoubtedly one of the smallest species of *Tornatellides* inhabiting the Hawaiian Islands. It is very common on the stems of the bunch grass near the Nuuanu Pali. *T. brunnea* is found on the same plants but usually occurs on the leaves.

In an immature specimen with 4½ whorls the parietal lamella is large and oblique, 0.18 mm. in height. The columellar folds are strong and nearly parallel, the upper is 0.07, the lower 0.11 mm. in height. The embryonic whorls are regularly spirally striate. The striæ are fine and widely spaced (fig. 13).

An embryonic specimen is almost globose. It has a narrow, cleft-like perforation. The columella is thickened longitudinally, a little back of the margin, forming a narrow longitudinal fold, which is bidentate. The parietal lamella is moderately developed. The surface of the shell is very minutely clathratulate (fig. 11).

Group of T. terebra.

Shells of 6-8½ compressed whorls, the last slightly flattened about the margin of the umbilicus. The *parietal lamella is serrate* or bears one or more acute projections.

This group is distributed on all the islands. Most of the species are found only on dead leaves and twigs.

a. Parietal lamella with fine spine-like serrations.

b. Adult shells with less than 7 whorls, and with the diameter more than 50 per cent of the length.

c. Parietal lamella of adult shells moderately developed, more than 0.1 mm. in height, outlines of spire convex.

d. Adult shells more than 2.5 mm. in length; parietal lamella serrate, the incisions about ⅓-½ its height.

T. forbesi, no. 52.

*d*¹. Adult shells less than 2.5 mm. in length; parietal lamella serrate nearly to its base.

T. f. nanus, no. 52*a*.

*c*¹. Parietal lamella of adult shells low, less than than 0.1 mm. in height; outlines of spire conic.

d. Diameter contained about 1.9 times in the length. *T. prionoptychia*, no. 50.

*d*¹. Diameter contained about 1.6 times in the length. *T. serrarius*, no. 51.

*b*¹. Adult shells with more than 7 whorls, and with the diameter less than 40 per cent. of the length.

T. terebra, no. 49.

*a*¹. Parietal lamella bearing a scythe-like process, and without spine-like serrations. *T. drepanophora*, no. 53.

49. T. TEREBRA (Ancey). Pl. 52, figs. 1, 2.

"Shell elongate, terebriform, thin, pellucid, light-corneous, under the lens lightly and closely impressed with growth lines, minutely perforate. Spire much produced, regularly, conically tapering, the apex minute. Whorls 7 to 7¼, closely coiled, a little convex. Suture somewhat impressed. Aperture small, somewhat oblique, truncate-oval, with a rather small and serrate parietal lamella. Columella provided with two folds, scarcely visible in adult shells. Peristome acute, unexpanded, the columellar margin minutely dilated and expanded. Last whorl short, rounded, somewhat saccate. Length 2.66, diam. 1.0, alt. apert. 0.75 mm." (*Ancey*).

East Maui: Kaupakalua (Baldwin), Hana (Forbes), Kaiula (Cooke). West Maui: Waikapu (Forbes), Maunahooma (Cooke). Molokai: Kaluaaha (Thaanum), Maunahui, Mapulehu (Cooke). Lanai (Forbes). Hawaii: Keehia (Thaanum). Type no. 18450 Bishop Museum.

Tornatellina terebra Ancey, Journ. de Conchyl., li, 1903, p. 303, pl. 12, f. 17, 18.

"I at one time referred this remarkable species to *T. perkinsi* Sykes, discovered by Mr. Perkins on the island of Kauai, which it resembles in the very much lengthened shape. Mr. Sykes, to whom I sent an example of *T. terebra,* has pointed out to me that the two species are different. *T. terebra* has a very curious peculiarity: the parietal lamella has the shape of a saw, of which the very acute and spiniform teeth are directed forward and are very regular and remarkably strong for so small a shell. The columella of immature individuals is provided with two folds which become very indistinctly apparent in the adult. The spire seems to be more acute than in *T. perkinsi,* and the whorls are even closer, while the size is smaller. This species appears to be constant in these characters. It is not common" (*Ancey*).

None of the specimens which we have seen from East Maui has over 7½ whorls. A specimen from Maunahooma, West Maui, has just 8 whorls and measures: length 2.95, diam. 1.1, axis of apert. 0.75, par. lam. 0.09 mm. In this specimen the columella is unarmed. A specimen from Lanai has 8½ whorls and measures: length 3.3, diam. 1.1, axis of apert. 0.73, par. lam. 0.11, umb. 0.12 mm. Both columellar folds are present, the upper being slightly stronger than the lower. A specimen (pl. 52, fig. 1) from Kaluaaha, Molokai, has 8½ whorls and measures: length 3.5, diam. 1.2, axis of apert. 0.8, par. lam. 0.12, umb. 0.12 mm. The apical whorls are lighter-colored than the rest of the shell and smooth. The suture is indistinctly margined, minutely and almost regularly crenulate. The surface of the shell is minutely striate. The columellar folds are minute, and the parietal lamella is incised to about one-half its height.

An immature specimen (pl. 52, fig. 2) from Mapulehu,

Molokai, has 5⅓ whorls. The columellar folds are slightly oblique, parallel and the lower is slightly stronger than the upper. An older specimen, with 7 whorls, has the columellar folds nearly equal in height.

50. T. PRIONOPTYCHIA C. & P., n. sp. Pl. 52, figs. 3, 4.

Shell perforate, conic, light brownish-corneous, slightly glossy, under a lens minutely irregularly striate, thin, translucent. Spire conic, with slightly convex outlines, apex subacute. Suture simple, subimpressed. Whorls 6, the first embryonic increasing very rapidly, the rest increasing slowly and regularly, the last ovate, tapering slightly towards the base, flattened about the umbilicus. Aperture auriform. Parietal lamella low, serrate nearly to its base, the spiniform serrations oblique and pointing outwards. Columella tumid, furnished with two low linear folds, both of which extend to the margin of the columella. Peristome thin, erect, with the outer margin almost regularly arcuate. Umbilicus rather large, circular. Length 2.45, diam. 1.3, axis of apert. 0.9, par. lam. 0.07, umb. 0.36 mm.

Oahu: Nuuanu, near the Pali, on dead leaves (Cooke). Type no. 36241 Bishop Museum, cotype no. 111842 P. A. N. S.

In an immature specimen with over 5 whorls (fig. 4), the parietal lamella is very strong, about 0.22 mm. in height, the front only is serrate, the serrations being more or less triangular and pointing outwards. The columella is furnished with two almost transverse folds, both of which extend nearly to the margin of the columella. The upper is 0.05, the lower 0.13 mm. in height. The embryonic whorls are very minutely spirally striate. In an immature specimen with less than 5 whorls the parietal lamella is entire.

The original material of this extremely interesting species was collected in 1904. Since then no additional specimens have been found, although the junior author has collected several times in the immediate locality, and once especially for this species. It probably is a very local species, limited to the dead leaves under an isolated tree or clump of trees.

The original and only material came from the second sub-

ridge south of the Nuuanu Pali, and consists of two adult and six immature specimens.

T. terebra is its closest relative. *T. prionoptychia* is broader in proportion to its length, and the spire is less produced, with more conic outlines.

51. T. SERRARIUS P. & C., n. sp. Pl. 52, figs. 6, 7.

The shell is ovate-turrite, umbilicate (the umbilicus open, well-like, the last whorl not deviating tangentially), light pinkish-cinnamon, somewhat transparent, not very glossy. Spire conic with straight outlines and subacute apex. Whorls 6⅓, convex, the last narrowly rounded around the large umbilicus, inside of which the columellar lamellæ can be seen through the shell. Aperture small. Parietal lamella long but not wide, serrate, bearing long points directed forward. Columellar margin broadly dilated. Columella convex above the middle, and bearing two very low, thread-like lamellæ, which reach weakly to the margin. Length 2.7, diam. 1.7, aperture 0.9 mm.; width of umbilicus 0.35 mm.

Oahu: Glen Ada (Pilsbry). Type no. 112539 A. N. S. P.

Related to *T. spaldingi,* which is a much shorter species, with only slight traces of serration on the parietal lamella; but in an entirely natural classification these two species belong together. The open, well-like umbilicus and serrate lamella separate *T. serrarius* from the widespread *T. macromphala. T. prionoptychia* is closely related, but it is a narrower shell with the umbilicus smaller within—the axial perforation only about half as wide as the orifice.

52. T. FORBESI C. & P., n. sp. Pl. 52, figs. 8, 9.

Shell perforate, convexly elongate, corneous, somewhat transparent, slightly glossy, with an oily luster, under a lens minutely and almost regularly striate with lines of growth. Spire convex in outline, apex rather blunt; suture lightly impressed, minutely and almost regularly crenulate. Whorls 6½, the embryonic smooth, increasing rapidly, the rest increasing slowly, slightly convex, the last compressed, with an almost truncate base. Aperture rather large, truncate-oval.

Parietal lamella low, serrate, in front the space between the serrations is partly filled, in back the spine-like serrations are free, about one-third the height of the lamella. Columella broadly triangular, furnished with two low, almost transverse and nearly equal folds, the lower of which extends to the margin of the columella. Umbilicus rather large, perspective, about one-fifth the diameter of the shell. Peristome thin, erect. Length 2.6, diam. 1.5, axis of apert. 0.85, par. lam. 0.12, umb. 0.33 mm.

West Maui: Waikapu (Forbes). Type no. 36239 Bishop Museum.

In an immature specimen with 5 whorls the lower columellar fold is large and transverse, and is much stronger than the upper. The latter is indicated by a low raised line and is remarkably weak for such a young shell. The serrations of the parietal lamella are more distinct than in the adult specimens. The embryonic whorls are smooth (fig. 8).

This is an extremely rare shell, of which only four specimens were found by Mr. Forbes, two adult and two immature. The convex outlines of the spire easily separate it from all other species of this group.

52*a*. T. FORBESI NANUS C. & P., n. subsp. Pl. 52, figs. 5, 10.

The shell is smaller than the typical form, thin, glossy, transparent. The aperture is rather large. The parietal lamella is low, cut nearly to its base by the elongate, spine-like serrations. The columella is broadly tumid, furnished with two equal low thread-like folds, both of which extend to the margin of the columella. The umbilicus is large, perspective, about one-fourth the diameter of the shell. Length 2.4, diam. 1.5, axis of apert. 0.92, par. lam. 0.11, umb. 0.38 mm.

Hawaii: Hilo; Reed's Island (Cooke) (type locality), Rainbow Falls (Thaanum, Cooke); Kukaehaele (Thaanum), Puna (Spalding), four miles Olaa (Cooke). Type no. 36240 Bishop Museum, cotypes no. 111720 P. A. N. S., and Thaanum's coll.

This variety seems to be widely distributed over the island of Hawaii, but is extremely rare. The specimens from Reed's

Island were collected on the leaves of honohono (*Commelina nudiflora*). This variety is shorter and broader in proportion to its length than the typical form. The parietal lamella is, also, more deeply cleft.

An embryonic shell, with just over two whorls, is perforate. The surface is nearly smooth with no indications of spiral lines. The columella is truncate below, the lower margin being formed by the lower columellar fold, the upper fold being merely indicated by an oblique swelling. The parietal lamella is entire (fig. 5).

53. T. DREPANOPHORA C. & P., n. sp. Pl. 52, figs. 11, 12, 13.

Shell perforate, narrowly turrited, corneous, somewhat glossy, under a lens minutely striate with lines of growth, thin, translucent. Spire elongately turrited, with slightly convex outlines, apex obtuse. Suture simple, impressed. Whorls 6⅓, the first increasing rapidly, the rest compressed, convex, increasing very slowly and regularly, the last slightly tumid, with a slightly flattened base. Aperture auriform, narrow. Parietal lamella low in front, higher in back, with a scythe-like tooth where the low and high portions unite, the back portion strongly arcuate above. Columella tumid, unarmed. Peristome (slightly broken in the type) thin, with slightly flattened outer margin. Umbilicus large, nearly circular. Length 2.15, diam. 1.0, axis of apert. 0.65, par. lam. 0.02 (in front) 0.09 (in back), umb. 0.39 mm.

Kauai: Puukapele, on dead fern leaves (Cooke). Type no. 36242 Bishop Museum.

An immature specimen with 4¾ whorls has no spiral lines on the embryonic whorls. The parietal lamella is entire, very large and curved outwards, 0.21 mm. in height. The columella is furnished with two almost transverse, rather deeply-seated folds, which are nearly equal in size. The upper is 0.07, the lower 0.09 mm. in height (fig. 13).

It is an extremely rare species, of which only three specimens have been taken. Its small size and the peculiar form of the parietal lamella easily separate it from other species of the group.

Subgenus Waimea C. & P., n. subg.

The shell is similar in form to *Tornatellides*. It differs in its *costate surface* and the broad, shallow, dorsal sulcus or depression on the last whorl. In immature specimens there is a rather *long, low palatal fold* and two columellar lamellæ. The embryonic whorls are spirally striate as in *Tornatellaria*.

54. T. rudicostatus (Ancey). Pl. 47, figs. 10, 11, 12.

Shell oblong-attenuate, perforate, whitish when dead (and very likely corneous in a fresh condition), remarkably ridged with close, acute, nearly straight, not regular liræ. Spire rather produced, conoid, rather obtuse. Whorls 6, convex, regularly increasing, separated by a suture crenulated by the ribs, the first whorl smooth, the last oblong, a little tapering, with a median concentric sulcus on the back and towards the aperture. Aperture slightly oblique, somewhat irregularly truncate-oval, in adults unarmed except for a strong parietal lamella. Columella a little thickened, arcuate. Peristome acute, unexpanded, the columellar margin dilated and expanded. Length 2½, diam. 1¼, alt. apert, ¾ mm. (*Ancey*).

In the young shell there are besides the parietal lamella two acute plicæ on the columella and a long transverse plica revolving within the palatal wall (Ancey).

Hawaii: fossil in the Hamakua district (Henshaw, Thaanum).

Tornatellina rudicostata Ancey, Journal of Malacology, xi, Sept. 29, 1904, p. 70, pl. 5, f. 20, 21.—Henshaw, t. c., p. 64.

An extraordinary species, quite unlike anything described in the genus. The general aspect is that of a very small *Leptachatina henshawi*, but the plicæ are coarser and irregular. The sculpture is quite unusual in the genus. No living forms are allied to this (*Ancey*).

The specimen figured in Ancey's paper is not adult. Ancey's type-specimen (no. 18448 Bishop Museum) is also an immature shell. The specimen (Bishop Mus. coll. no. 14152) figured on pl. 47, figs. 10, 12, has 6½ whorls and measures:

length 2.9, diam. 1.3, axis of aperture 1.1 mm. The parietal lamella is 0.13 mm. in height. There are 26 costæ on the last whorl. This specimen was collected by Henshaw and is from the original lot of dirt from which Ancey's type was selected.

This and *T. waianaensis* are the only Hawaiian perforate species having an entering or spiral palatal plica. This character is found in some of the Hawaiian species of *Elasmias* and *Auriculella*. In all it occurs in the neanic stage, disappearing in maturity.

In very young specimens the two columellar folds are rather strong, slightly oblique and of about an equal size. In slightly older specimens the upper columellar fold is a little stronger than the lower (fig. 11).

Mr. Thaanum has searched the region from which the fossil material came, but was unable to find living examples of this species.

Genus TORNATELLARIA Pilsbry.

Tornatellaria Pils., Nautilus xxiii, March, 1910, p. 123, type *T. newcombi*.

Tornatellinidæ with the shell perforate or umbilicate, thin, dextral; shape from ovate to pyramidal-conic, the outlines of the spire nearly straight; whorls 6½ to 9½, flattened or not very convex; apex minutely striate spirally, surface smoothish. Parietal lamella from two-thirds to an entire whorl long. Two columellar lamellæ in the young stages, one or both emerging in the adult. Peristome thin, unexpanded and acute. Mantle marked with narrow black blotches and lines transverse to the whorls. Oviparous.

Type: *T. newcombii* Pfr. Distribution: Hawaiian Islands, except Niihau and Kahoolawe.

These small forest snails are like *Tornatellides* in being thin, self-colored or nearly so, and umbilicate. They are separated from *Tornatellides* chiefly by reason of their oviparous reproduction (the other genus being viviparous), and also by the more deeply entering parietal lamella. Usually, too, the shape is more strictly conic or pyramidal, and the whorls are flattened. The genus is neither so generally distributed nor so

prolific in species as *Tornatellides*. It is also more primitive than *Tornatellides*, both by the mode of reproduction and by the greater similarity of the lamellæ of the young and adult stages.

The oviparous reproduction and the system of apertural lamellæ are alike in *Tornatellaria* and the less evolved groups of *Auriculella*. The genus *Gulickia*, closely related to *Auriculella*, is also much like *Tornatellaria*. There seems to be real affinity between these three genera. But *Auriculella* and *Gulickia*, even when umbilicate at the last whorl, have the axis solid until the ephebic stage, while in *Tornatellaria* the axis is perforated throughout.

To the generic characters given above we may add that the surface may be either glossy, silky or dull. It is minutely striate with lines of growth. The spire varies from slightly concave to convex in outline. The embryonic shell, of just over two whorls, is regularly, spirally striate, the striæ being in the form of slightly raised lines. In immature specimens the lower columellar lamella is usually stronger than the upper, but in five species (*newcombi, lilæ, umbilicata, anceyana* and *baldwiniana*) the reverse is found. In most of the species, when examined under a high-power lens, the margin of the parietal lamella is seen to be indistinctly and irregularly serrate. In *T. anceyana* the serrations are distinct and regular. By its convex whorls, few in number, the last one rotund, *T. baldwiniana* looks like a *Tornatellides*; but the other species have a distinct facies which one soon learns to recognize.

The identification of specimens is somewhat difficult in this genus, on account of the similarity of several of the Molokai-Maui-Hawaiian species. The types of all the species have been examined in the preparation of this monograph. Types of all but one species are in the collections of the Bishop Museum and Academy of Natural Sciences.

The species of *Tornatellaria* are terrestrial. They are usually found on dead leaves and twigs where the ieie (*Freycinetia arnotti*) and kukui (*Aleurites moluccana*) are growing. A few specimens are sometimes taken on the trunks of

living trees within a foot or two of the ground. They appear to be partial to rather damp stations.

The greatest differentiation of the genus has taken place on Maui. The three most dissimilar species, *anceyana, abbreviata* and *baldwinana*, are found on this island. *Tornatellaria* is extremely rare on the island of Kauai. The only species so far reported from there is *T. newcombi*, a common Oahuan form. We suspect that it is a recent introduction, and that Kauai was without representatives of *Tornatellaria,* as it was without *Auriculella* or *Achatinella.* The distribution of the group strongly suggests that the Lanai-Molokai-Maui region was its center of dispersal.

Several of the Lanai-Molokai-Maui species are common to two or three of these islands, and the Hawaiian species are very closely related to them. The Oahuan species are all different from those of the eastern islands.

Distribution of Tornatellariæ.

	Lilæ.	Adelinæ.	Occidentalis.	Newcombi.	Stokesi.	Umbilicata.	Trochoides.	Cincta.	Anceyana.	Henshawi.	Sykesi.	S. illibuta.	Convexior.	Abbreviata.	A. hawaiiensis.	Smithi.	Sharpi.	Baldwini.	
Kauai.	.	.	.	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Oahu	*	*	*	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Molokai.	.	.	.	.	.	*	*	*	.	.	.	*	.	.	.	.	.	.	4
Lanai.	.	.	.	.	.	.	*	*	.	.	.	.	.	.	.	.	.	.	2
W. Maui.	.	.	.	.	.	*	.	*	.	.	.	.	.	.	.	.	.	*	3
E. Maui.	.	.	.	.	.	.	.	*	*	.	.	.	.	*	.	.	.	.	3
Hawaii	.	.	.	.	.	.	*	.	.	*	*	.	*	.	*	*	*	.	7

Key to species of Tornatellaria.

a. In adult specimens the diameter less than 60% of the length.
b. Adult shells with more than 7 *nearly flat* whorls.
c. Parietal lamella more than 0.3 mm. in height.
d. Parietal lamella not eroded in front, outlines of spire scarcely convex.
e. Base somewhat flattened, shell glossy. *T. umbilicata*, no. 6.
e^1. Base tapering, shell not glossy. *T. cincta*, no. 8.
d^1. Parietal lamella eroded in front, outlines of spire slightly convex.
e. Wider, 4.4 x 2.6 mm. *T. sykesii*, no. 11.
e^1. Narrower, 4.4 x 2.4 mm. *T. convexior*, no. 12.
c^1. Parietal lamella less than 0.3 mm. in height.
d. Parietal lamella more than 0.2 mm. in height.
e. Umbilicus very minute, less than 1/15 diam. of the shell. *T. henshawi*, no. 10.
e^1. Umbilicus 1/6-1/10 diam. of the shell.
f. Periphery encircled by a broad light zone. *T. s. illibuta*, no. 11*a*.
f^1. Periphery *not* encircled by a broad light zone. *T. trochoides*, no. 7.
d^1. Parietal lamella less than 0.2 mm. in height.
e. Base slightly flattened, outlines of spire slightly convex.
f. Only the upper columellar lamella emerges; umbilicus contained about 6⅓ times in

diam. of base.

T. occidentalis, no. 3.

f^1. Two columellar lamellæ emerging.

g. Umbilicus about one-sixth the diam. of base.

T. adelinæ, no. 2.

g^1. Umbilicus one-eighth the diameter or less.

T. newcombi, no. 4.

e^1. Base tapering, outlines of spire slightly concave.

T. anceyana, no. 9.

b^1. Adult shells with less than 7 *convex* whorls.

T. baldwiniana, no. 16.

a^1. In adult specimens the diameter is 60% or more of the length.

b. Parietal lamella 0.2 mm. in height or more.

c. Umbilicus large, about one-sixth the diam. of base. *T. adelinæ* var., no. 2.

c^1. Umbilicus minute.

d. Only the upper columellar lamella emerging, shell obese. *T. abbreviata*, no. 13.

d^1. Two columellar lamellæ emerging.

e. Shell larger, over 4 mm. long.

T. a. hawaiiensis, no. 13*a*.

e^1. Shell smaller, less than 3.5 mm. long.

f. Parietal lamella entire anteriorly. *T. stokesi*, no. 5.

f^1. Parietal lamella excised anteriorly. *T. sharpi*, no. 15.

b^1. Parietal lamella less than 0.2 mm. in height.

c. Adult shells with more than 7 almost flat whorls. Shells not glossy. *T. lilæ*, no. 1.

c^1. Adult shells with less than 7 slightly convex whorls. Shells glossy. *T. smithi*, no. 14.

1. T. LILÆ C. & P., n. sp. Pl. 54, figs. 1, 2.

Shell narrowly and deeply umbilicate, ovately turrited, dark corneous, dull, very closely and lightly striated, quite thin. Spire conic. Outlines very slightly convex, apex subacute. Suture simple, hardly impressed. Whorls 7½, nearly flat, the embryonic convex, the last angular at the periphery, with a slightly convex, very short base. Aperture broadly truncate ovate, rather small. Parietal lamella low, oblique. Columella simple, expanded over the umbilicus, furnished with two scarcely oblique, thin, corneous folds; the upper stronger than the lower and extending nearly to the margin of the columella. Peristome thin, above the obliquely angled periphery nearly straight, arcuate below. Length 3.9, diam. 2.5, axis of apert. 1.5 mm. Height of parietal lamella 0.14 mm.

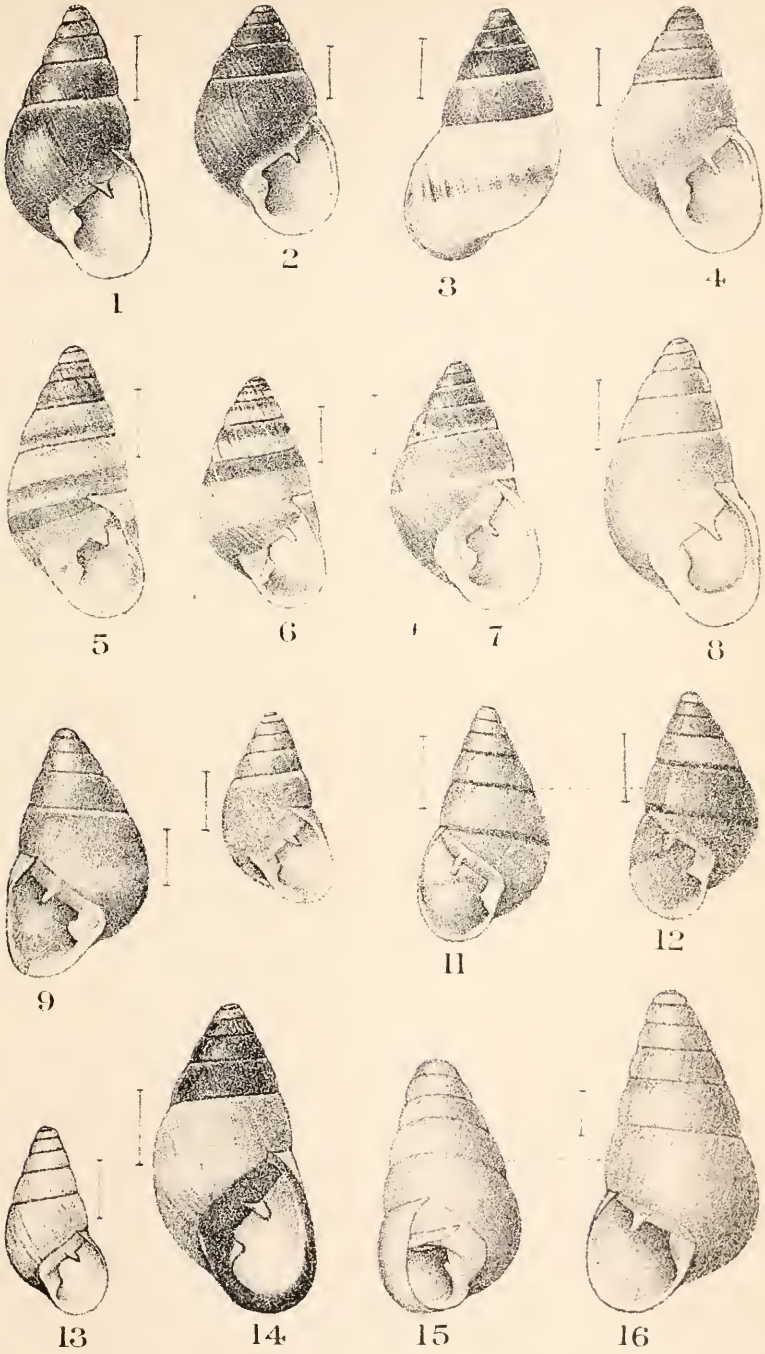
Oahu: central and eastern portion of the Waianae Mts. Type locality, ridge west of Kolekole Pass on the Leilehua side. Type no. 18424 Bishop Museum, cotypes 13666 B. P. B. Mus. and 112748 A. N. S. P.

Related to *T. newcombi*, but broader in proportion to its length, with a larger umbilicus, flatter whorls, of which the last, in adult specimens, is angular at the periphery, and a much shorter base. It is wider than *T. adelinæ*, and differs by the angulation.

In *T. lilæ* the umbilicus is larger relative to the diameter of the shell than in any other species of the genus except *T. adelinæ*, being ⅕-⅛ of the basal diameter. The upper columellar fold is stronger than the lower. The embryonic whorls are encircled with about 10 spiral striæ. The parietal lamella is 0.14-0.22 mm. in height and is minutely serrate along its margin.

2. T. ADELINÆ P. & C., n. sp. Pl. 54, figs. 3, 4.

The shell is umbilicate (width of umbilicus contained nearly six times in the diameter of the base), pyramidal, pale brown; very finely but sharply striate. Outlines of the spire are barely convex, nearly straight, the individual whorls being very slightly convex. Apex rounded. The last whorl is rounded peripherally and most convex around the umbilicus.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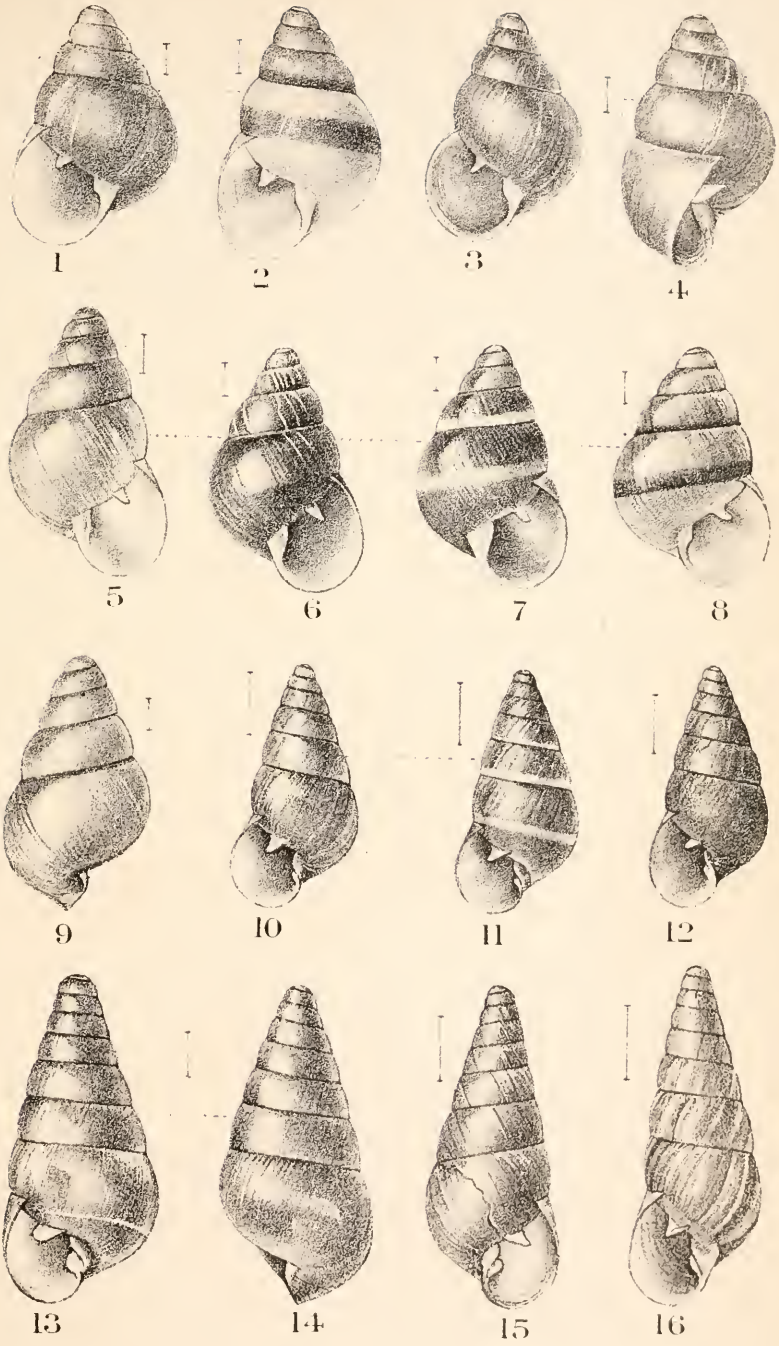
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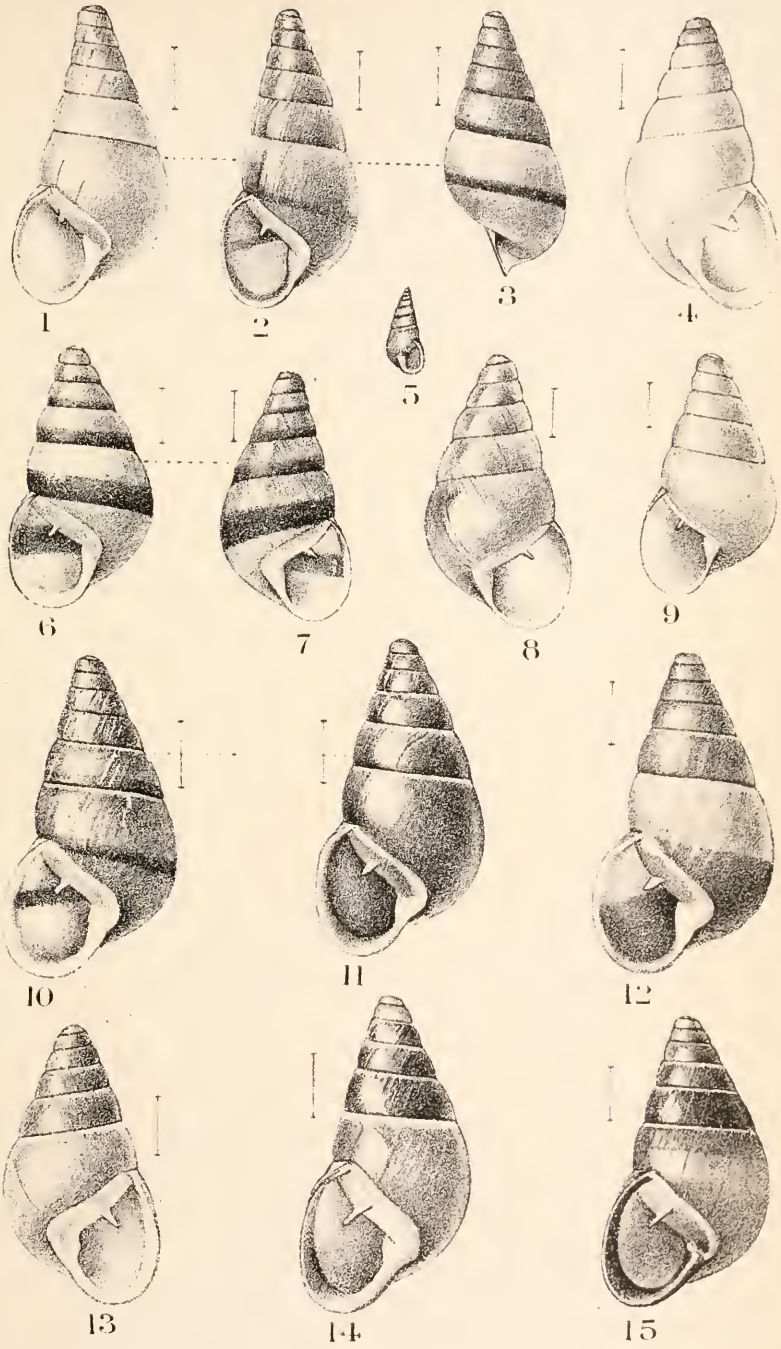
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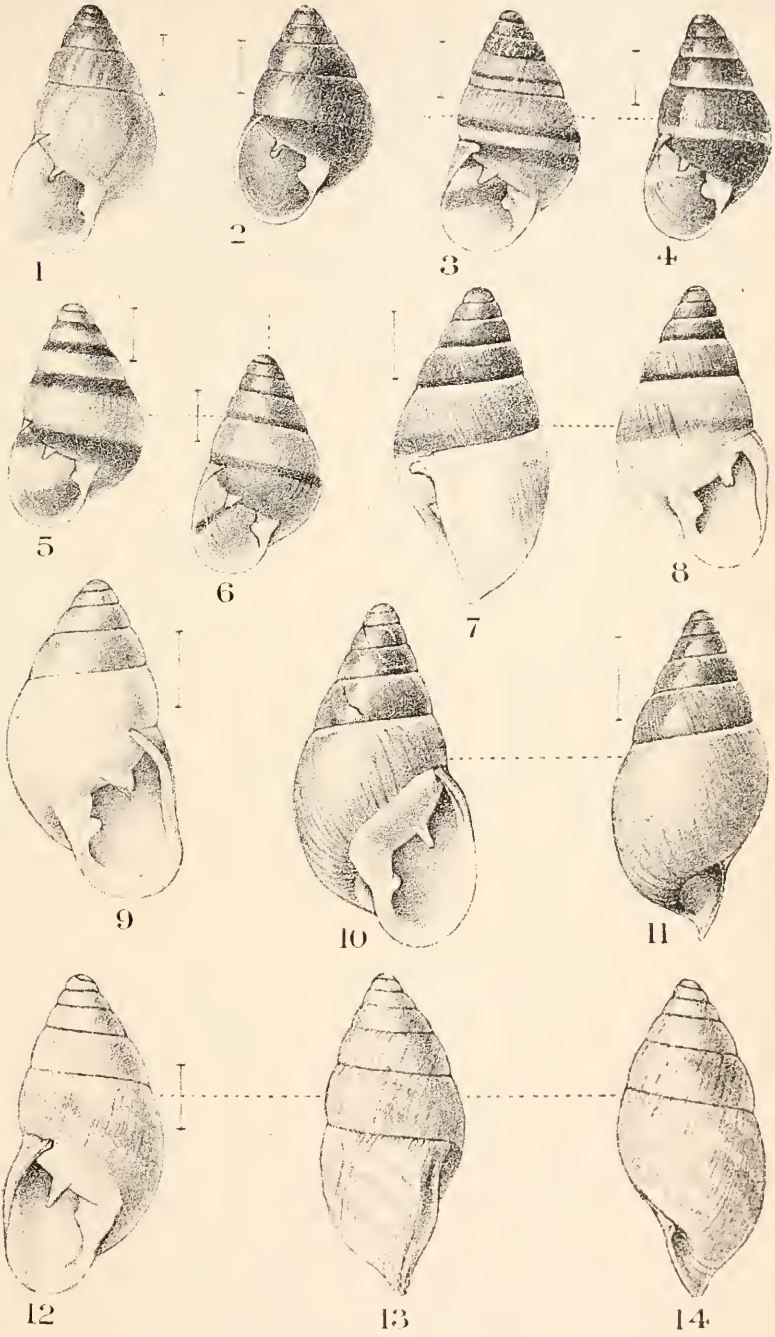
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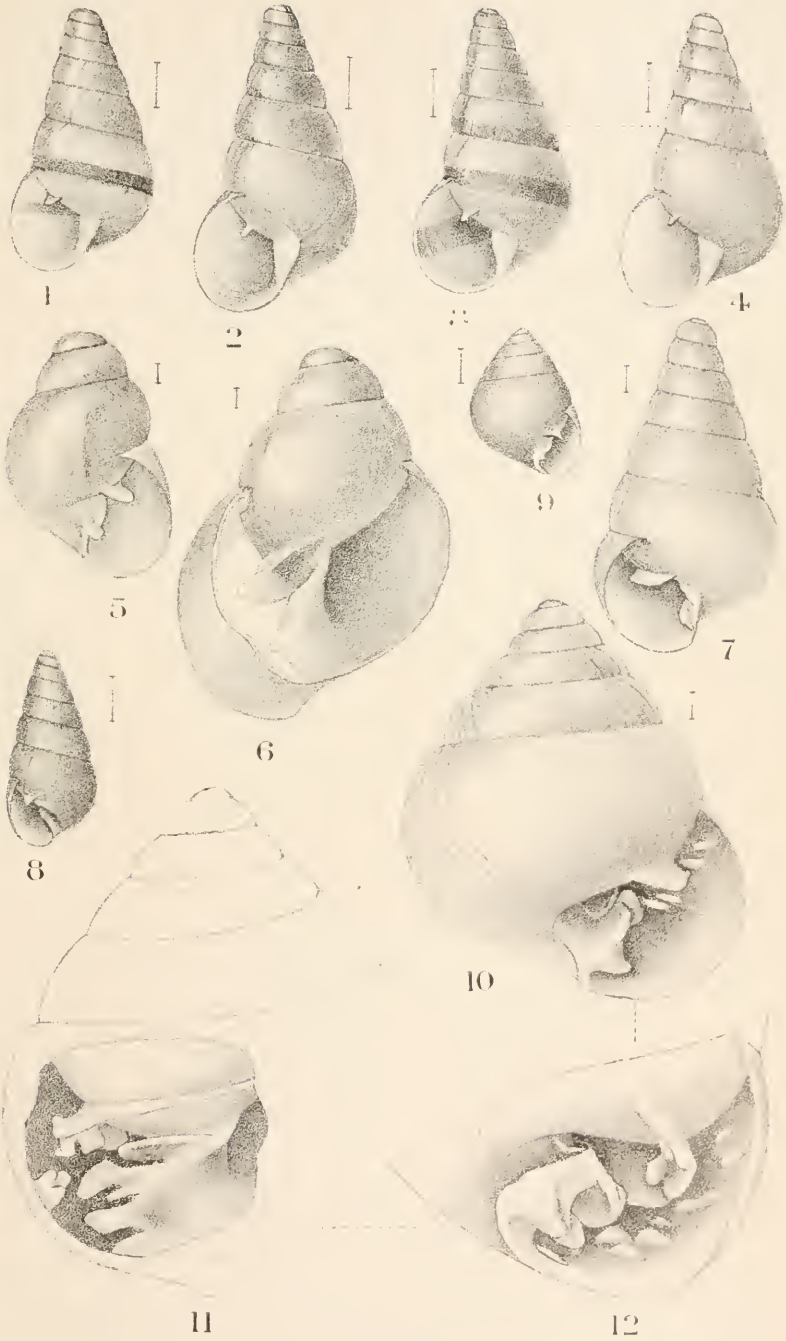
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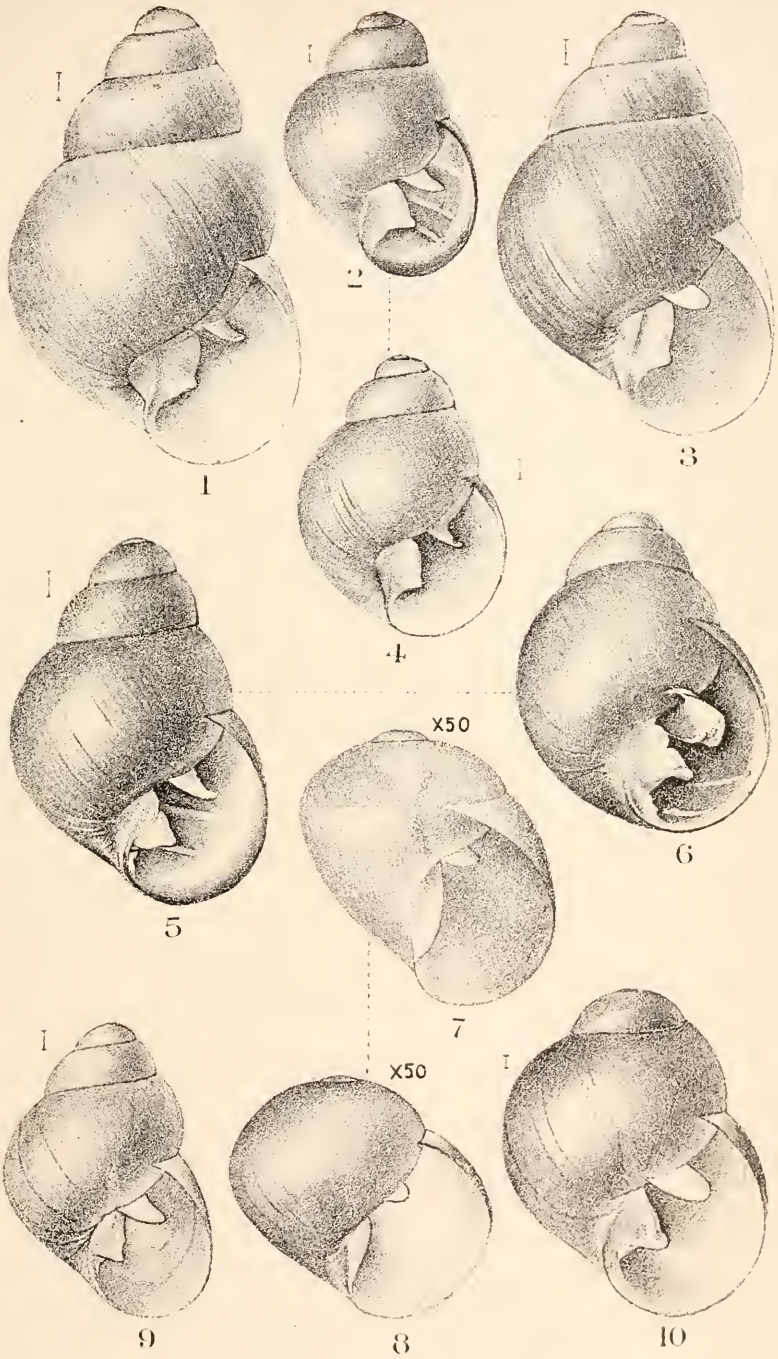
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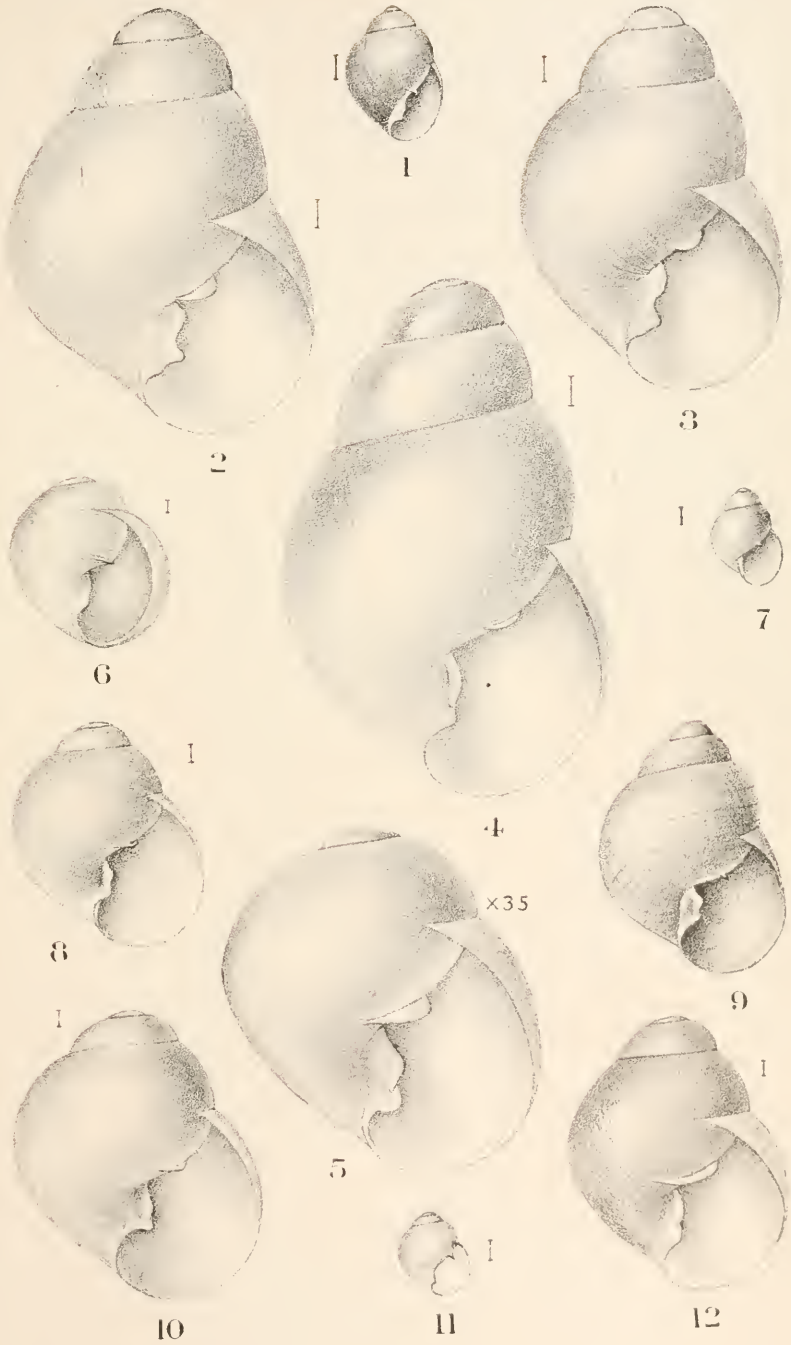
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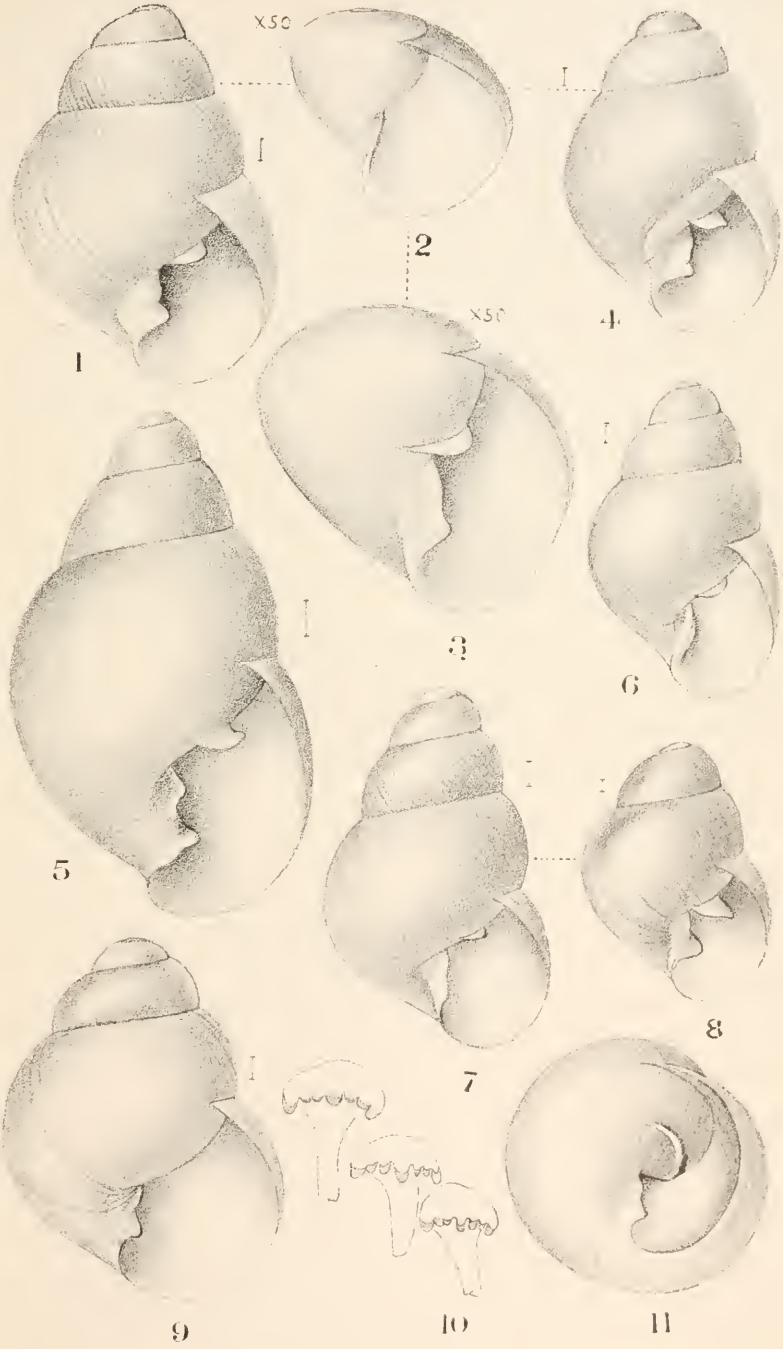
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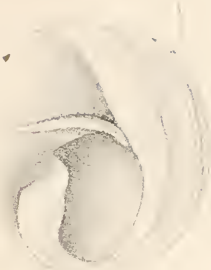

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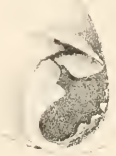

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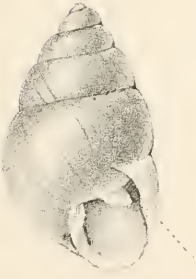
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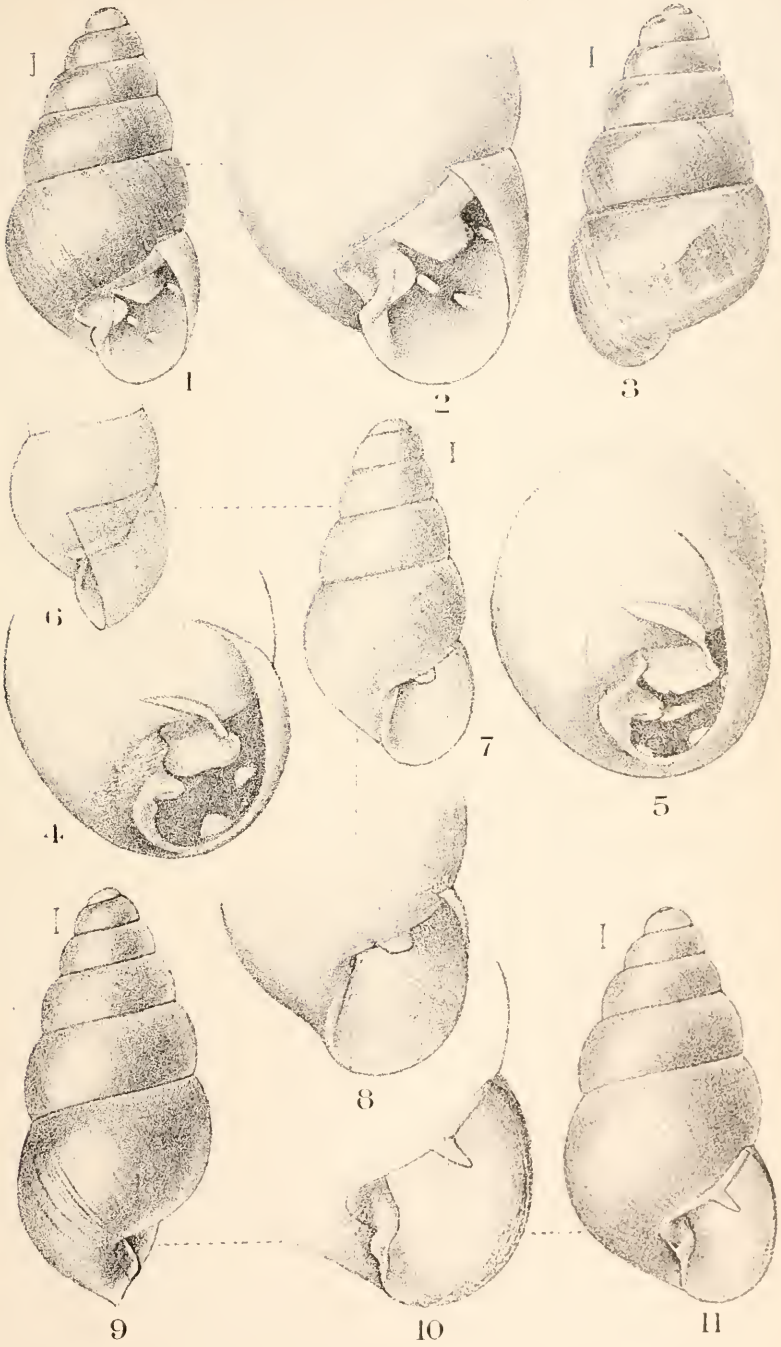
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The ovate aperture is deeply excised by the penult whorl, and has a low but long parietal lamella. Columellar lamellæ two, emerging, the upper one larger. Length 4.2, diam. 2.3, aperture 1.4 mm.; width of umbilicus 0.4 mm. Whorls 8.

Oahu: Mt. Tantalus, on the Castle Trail, Panoa slope. Cooke & Pilsbry, 1913. Type no. 112744 A. N. S. P., cotype in coll. Bishop Mus. Also Glen Ada, Nuuanu (Pilsbry).

By its ample umbilicus this species is related to *T. lilæ*, from which it differs by the less obese shape and the rounded, narrower, last whorl. In *T. occidentalis* only the upper columellar lamella emerges, and the umbilicus is quite noticeably smaller.

In both of the localities mentioned, a wider form occurs: length 4, diam. 2.45, width of umbilicus 0.5 mm., whorls nearly 8 (pl. 54, fig. 7). This may perhaps prove racially distinct, but from the material examined we do not think so.

3. T. OCCIDENTALIS P. & C., n. sp. Pl. 54, figs. 5, 6.

The shell is narrowly umbilicate (greatest width of umbilicus contained 6⅓ times in the diameter of the base), pyramidal, pale brown; very finely but sharply striate. Spire having almost straight lateral outlines, the individual whorls being very slightly convex; apex rounded, obtuse. Last whorl convex, not angular, the base strongly convex around the umbilicus, less so toward the periphery. The irregularly ovate aperture has a rather strong parietal lamella. Columella reflexed, the upper lamella emerging nearly to the lip-edge (or sometimes only enough to become visible in a front view); lower lamella immersed, not visible in adult shells. Length 3.9, diam. 2.2 mm., width of umbilicus about 0.34 mm.; 7½ whorls.

Oahu: western ridge of Popouwela, Waianae Mountains, Spalding, Cooke & Pilsbry. Type and paratypes no. 108892 A. N. S. P., eotype in Bishop Museum.

This species differs from *T. newcombi* in the following details: It is smaller and darker colored; the base is more shortened; umbilicus larger; only the upper columellar lamella is visible in the adult stage. In *T. adelinæ* the umbilicus is wider and both columellar lamellæ emerge.

In the ananeanic and metaneanic substages there are two equal columellar lamellæ, but the lower one then diminishes. This species was taken in large numbers in the "Endodonta colony", among dead leaves on the ground.

4. T. NEWCOMBI (Pfeiffer). Pl. 54, figs. 9, 10.

Shell perforate, ovate-turrite, thin, nearly smooth, a little shining, pale corneous. Spire rectilinear, conic, rather obtuse. Whorls 7, nearly flat, the last hardly one-third the total length, convex at the base. Aperture oblique, rotund-lunar, obstructed by a moderate parietal lamella and two parallel columellar folds. Peristome simple, unexpanded. Length 4, diam. 2⅓, aperture 1⅔ mm. long (*Pfr.*).

Hawaiian Islands (Newcomb). Kauai: Kilohana, Wainiha (Cooke). Oahu (Baldwin, Ancey); Waianae Mts., western slope (Lyman, Cooke); Kaipapau, Nuuanu, Konahuanui Manoa, Tantalus, etc., (Cooke). Type in British Museum.

Tornatellina newcombi PFR., P. Z. S. 1856, p. 335; Monogr. Hel. Viv. iv, 653.—ANCEY, Journ. of Malacology xi, p. 69. —HENSHAW, t. c. p. 63.—*Tornatellina* (*Tornatellaria*) *newcombi* Pfr., PILSBRY, Nautilus xxiii, 1910, p. 124. (Not *Pupa peponum*, var., Gould, ANCEY, Bull. Soc. Malac. France vi, 1889, p. 239, *Tornatellides* sp.).

T. newcombii is distinguished by its very narrow umbilicus, two emerging columellar lamellæ, the whitish corneous tint, and by having the base less shortened than in other known Oahuan species.

This species is limited to the islands of Kauai and Oahu. On the former island it has been taken in two localities only. It is abundant on the whole Koolau range of Oahu but is seldom met with in the Waianae mountains except on the western slope above Waialua.

The specimens from Honolua, W. Maui, which Mr. Ancey referred to this species, are young *T. cincta* Anc. (Bishop Mus. Coll. no. 18479).

The fossil form reported from Hawaii is distinctly *T. trochoides*.

The type specimen in the British museum is not quite ma-

ture, as there is a slight angle at the periphery. In adult specimens this angle entirely disappears.

There are about 14 spiral striæ on the embryonic whorls of this species. The parietal lamella is 0.1-0.2 mm. in height and is very minutely serrate along its margin. The umbilicus is from one-eighth to one-tenth of the diameter of the shell. In immature specimens the upper columellar fold is usually slightly stronger than the lower.

Pl. 54, figs. 9, 10 represent a specimen from the Waianae Mts. above Waialua compared with the type in the British Museum. A series of specimens from Kauai and different parts of Oahu were compared with the type and this specimen was nearly identical. It is fully adult, has 7½ whorls and measures length 4.2, diam. 2.3, axis of apert. 1.5 mm. The Waianae mountains above Waialua may be considered the type locality, as it is known that Newcomb collected in this region.

Another specimen, from Kaipapau, Oahu, with 8 whorls is shorter, it measures length 3.9, diam. 2.4, axis of apert. 1.5 mm. The specimens from Kauai are identical with those from Oahu.

A shell (no. 10026 A. N. S. P.) from Dr. Newcomb, probably a topotype, though no locality is given, measures 4.2 mm. long, 2.3 wide, with 7 whorls.

5. T. STOKESI P. & C., n. sp. Pl. 54, fig. 8.

The shell is perforate, ovate-conic, cinnamon-colored, glossy, with faint, irregular striation. Outlines of spire barely convex, nearly straight. Whorls 6½, slightly convex, the last rotund. Parietal lamella broad, a little more than a half whorl long, entire and tapering in front. Columellar lamellæ emerging to the edge, the upper one a little more oblique and less prominent than the lower. Length 3.1, diam. 2, length aperture 1.2 mm.; height of parietal lamella 0.25 mm.

Oahu: Glen Ada, Nuuanu (Pilsbry). Type no. 112747 A. N. S. P.

Shorter and more obese than *T. newcombi*, but like that in having a minute umbilicus. In other Oahuan species the

umbilicus is conspicuously wider. It is less conic than *T. sharpi* of Hawaii. Named for Mr. John F. G. Stokes, ethnologist of the Bishop Museum.

6. T. UMBILICATA (Ancey). Pl. 54, figs. 11, 12.

Shell glossy (in the young state), openly and deeply umbilicate, the umbilicus minute, punctiform, rufous-corneous, dextral, smooth, pellucid, thin, ovate-conic. Spire conoidal, the apex a little obtuse, long. Whorls (in immaturity) 7½, regularly and slowly increasing, the upper ones more convex, lower scarcely convex, narrowly pellucid-margined; the last whorl short, swollen. Aperture oblique, emarginate, angular above, with a very strong, compressed, very prominent revolving parietal lamella. Columella acutely biplicate, the upper fold stronger. Dimensions of the young specimens described above, length 3.75, diam. 2.5, alt. apert. 1.33 mm. (*Ancey*).

West Maui: Lahaina (type loc.) (Baldwin), Maunahooma (Cooke). Molokai: widely distributed over the eastern half (Thaanum, Cooke & Pilsbry). Type no. 18451 Bishop Mus.

Auriculella umbilicata ANCEY, Bull. Soc. Malac. France vi, 1889, p. 232.—*Tornatellina umbilicata* ANCEY, Mém. Soc. Zool. France v, p. 721.

T. umbilicata is intermediate between *T. trochoides* Sykes and *T. newcombi* Pfr. It is more closely related to the former but differs in its glossier surface, more convex whorls, shorter base and higher parietal lamella. From *T. newcombi* it differs, mainly, by its smaller umbilicus and higher parietal lamella.

Typical specimens from Maunahooma measure length 3.9-4.25, diam. 2.25-2.5, axis of apert. 1.6 mm. Height of parietal lamella 0.33-0.36 mm. The umbilicus is 1/10-1/14 of the total diameter of the shell. The parietal lamella is minutely serrate along its margin. The spiral striæ on the embryonic whorls are very low and indistinct. In immature specimens (fig. 12) the upper columellar fold is slightly stronger than the lower.

Mr. Ancey at first described this species as a young *Auriculella*, but subsequently he recognized that the shells were nearly adult *Tornatellinas*.

7. T. TROCHOIDES (Sykes). Pl. 54, figs. 13-17; pl. 55, fig. 9.

Shell deeply perforate, corneous, pyramidal, pellucid, nearly smooth. Spire conoidal, the apex rather acute. Whorls 7-7½, regularly and slowly increasing, flattened, the last subcarinate at the periphery, suture impressed. Aperture quadrate-ovate, angular above, bearing a strong, conspicuous parietal lamella. Columella brown, thickened, provided with two plicæ. Length 4, diam. 2 mm. (*Sykes*).

Lanai (Perkins, Thaanum, Spalding), Molokai (Thaanum, Cooke), Hawaii: Waimea (Thaanum), fossil (Henshaw).

Tornatellina trochoides SYKES, Fauna Hawaiiensis, ii, Moll., p. 383, pl. 11, f. 31 (1900).

"Closely related, apparently, to *T. umbilicata* Ancey, but differs from it in the relative proportions of height and breadth" (*Sykes*).

It also differs by its less polished surface, *smaller parietal lamella* and *flatter whorls.*

T. trochoides and *T. cincta* are very intimately connected. In the former the parietal lamella is weaker, the base shorter, the umbilicus is slightly larger and the whorls more closely coiled. It is by no means an easy matter to determine Molokaian Tornatellariæ.

T. trochoides was described from a shell not absolutely mature. The original figure is copied on pl. 55, fig. 9.

A cotype, received from Mr. Sykes, pl. 54, fig. 16, has 7 whorls and measures, length 3.7, diam. 1.95, axis of aperture 1.4 mm. None of the cotypes received by the Bishop Museum were wholly mature specimens, and in all of them the lower columellar fold is slightly stronger than the upper. The parietal lamella is minutely serrate along its edge; the suture is indistinctly margined; and there are about ten low distinct spiral striæ on the embryonic whorls. The umbilicus is about 1/6 of the total diameter of the shell.

A lengthened form from Lanai, pl. 54, figs. 13, 14, measures length 5, diam. 2.5 long, axis of aperture 1.6 mm., with 9⅓ whorls.

This species is widely distributed over the eastern half

of Molokai. In immature specimens from this island the upper columellar fold is slightly stronger than the lower.

A form of *T. trochoides* is also found on Hawaii. Living examples were collected at Waimea by Mr. Thaanum. The whorls are not as closely coiled as in typical specimens of *trochoides* and the spire is slightly more convex in outline. The parietal lamella is decidedly weaker. The shells are slightly shorter and broader. What appears to be a nearly adult shell with 6¾ whorls measures: length 4.2, diam. 2.5 mm.

The fossil material from Hawaii is much closer to the typical form, scarcely distinguishable. Adult specimen with 7¾ whorls measures, length 4.05, diam. 2.15 mm. This is undoubtedly the form erroneously referred to *T. newcombi* by Ancey, Journ. of Malac. xi, 1904, p. 63.

8. T. CINCTA (Ancey). Pl. 55, figs. 1, 2.

Shell long-conic, minutely umbilicate, thin, fulvous, the last whorl encircled by a more or less distinct whitish median zone. Spire long, conic, rectilinear, the apex minute, a little obtuse. Whorls 8, flat, parted by a linear suture, nearly smooth, having a rather oily gleam, narrowly coiled, regularly and slowly increasing, the last indistinctly angular, chiefly at its beginning, rather short, quite abruptly tapering. Aperture oblique, armed in the middle of the parietal wall with a compressed, very prominent, whitish, thin, revolving lamella. Columella acutely biplicate, straight, the folds oblique, subequal, reaching to the margin. Peristome simple, acute, unexpanded, the columellar margin expanded in a long triangle over the umbilicus; margins remote. Length 5, diam. 2.5, aperture 2 mm. (*Ancey*).

E. Maui: Mukuwae, Kaupakalua (Baldwin); W. Maui: Iao Valley (Thaanum), Lahaina (Forbes, Cooke). Molokai (Baldwin, Thaanum, Cooke & Pilsbry). Lanai (Forbes).

Tornatellina cincta ANCEY, Journ. de Conchyl. li, 1903, p. 297, pl. 12, f. 5, 6; Journ. of Malacology xi, p. 69.

This shell, large for the genus, is doubtless spread over the whole Hawaiian archipelago, though it has not yet been re-

corded from Kauai or Lanai. Desiring to clear up the question of its identity with *T. newcombi* Pfr., I submitted specimens to Mr. Edgar A. Smith of the British Museum, where the types of Pfeiffer's species are deposited. He reported that *T. cincta* differs by the more robust parietal and columellar lamellæ, narrower umbilicus and more angular last whorl (*Ancey*).

Unfortunately Mr. Ancey did not designate the type lot of this species in his collection. There are two lots named by him, the first from Lahaina, West Maui, and the second from Kaupakalua, East Maui. There are unnamed lots in his collection from Makawao (1) and Kaupakalua (6) E. Maui, and from Lahaina (1) W. Maui. The junior author has selected the Makawao lot (no. 18500 Bishop Mus.) as the type (p. 55, fig. 1). Although not labeled, it is the only species of *Tornatellaria* in the Ancey collection from this locality,—the locality first mentioned in his description. The finest specimen in this lot has 8 whorls and measures, length 5.1, diam. 2.5, axis of apert. 1.8 mm. Parietal lamella 0.33 mm. in height. These measurements agree fairly well with those given by Ancey. Fig. 2 is from a Mapulehu example. A specimen in the Ancey collection from Iao Valley (Bishop Mus. 18473) measures length 4.7, diam. 2.25, axis of apert. 1.8 mm. We have been unable to find typical specimens of this species from Hawaii or Oahu in the Ancey collection. The fossil material identified by Ancey for Henshaw as *T. cincta* is referable to *T. henshawi* rather than to *T. cincta*, and has been placed with the former species. There is no doubt that these two species are very intimately related.

In *T. cincta* the umbilicus is from 1/7-1/10 of the diameter of the shell. The parietal lamella is very minutely serrate along its edge. In immature specimens though the columellar folds are very nearly equal, the lower is slightly more strongly developed. The spiral striæ of the embryonic whorls are low and indistinct.

9. T. ANCEYANA C. & P., n. sp. Pl. 55, fig. 4.

The shell is perforate, turrited, corneous, rather thin, trans-

parent, somewhat shining, nearly smooth, minutely striate with lines of growth. Spire long conic, with *slightly concave outlines*. Suture simple, lightly impressed. Whorls 7¾, slightly convex, the post-embryonic closely coiled, the rest increasing slowly, the last slightly tumid, tapering towards the base. Aperture slightly larger, proportionately than those of most of the species of the genus, ovate. Parietal lamella moderately developed, slightly oblique, its margin more distinctly serrate than in any of the other species. Columella nearly straight, expanded above the umbilicus, with two nearly equal (the upper slightly stronger than the lower), well developed folds, extending nearly to the margin. Peristome thin, unexpanded, arcuate. Length 3.7, diam. 1.8, axis of apert. 1.4 mm. Height of parietal lam. 0.18 mm.

E. Maui, Kaupakulua (Baldwin). Type no. 18424 Bishop Mus.; cotype 111853 A. N. S. P.

Closely related to *T. trochoides* and *T. cincta* but easily recognized by its smaller size, *narrower form*, more attenuate spire with *slightly concave outlines*, and the more distinctly serrate parietal lamella. The serrations are conic and rather distantly separated. The embryonic whorls are encircled by low indistinct spiral striæ.

This species is rather rare.

10. T. HENSHAWI (Ancey). Pl. 55, fig. 3.

Shell oblong, conic-turrite, thin, glossy, smooth, brown-corneous, minutely perforate. Spire long, conic, rectilinear or with the sides slightly convex, the summit minute, a little obtuse. Whorls 7½, slowly increasing, nearly flat, separated by an appressed, superficial suture, the last whorl short, rounded, very slightly, obscurely angular at the beginning, base convex. Aperture oblique, round-emarginate, armed with a moderate parietal lamella and two equal oblique columellar folds. Columella narrowly dilated above the perforation. Peristome simple, acute, unexpanded, the margins remote. Length 5 mm (*Ancey*).

Hawaii: Hamakua (H. W. Henshaw); Olaa (D. Thaanum); Waimea fossil (H. W. Henshaw). Type no. 18436 Bishop Mus.

Tornatellina henshawi Ancey, Journ. de Conchyl. li, 1903, p. 299, pl. 12, f. 9, 10.—*T. cincta* Anc., Journ. of Malac. xi, 1904, p. 63.

A species related to *T. abbreviata* but decidedly more lengthened and having more whorls. It is intermediate between the latter and *T. newcombi* Pfr., *T. cincta* Anc., but differs from these two forms by the closer whorls, and from the first by the narrower umbilicus, more numerous whorls, larger size and so on; from the second by the weaker folds and lamellæ, the last whorl very little or not at all angular at its origin, and the smaller umbilicus (*Ancey*).

The type specimen measures, length 4.9, diam. 2.6, axis of apert. 1.8 mm. The parietal lamella is 0.25 mm. in height.

This species is most closely related to *T. sykesi* P. & C. from the same island. In the former species the outlines of the spire are less convex, the umbilicus is narrower, the parietal lamella is not as strong and the upper columellar fold less strongly developed.

The spiral striæ on the apical whorls of *T. henshawi* are very low and indistinct on all the specimens at hand. The umbilicus is less than 1/20 of the diameter of the shell.

Figured from a cotype.

A specimen (Bishop Mus. no. 34027) from the fossil beds of Waimea, collected by Mr. Henshaw, measures, length 5.8 diam. 2.8 mm. and has 8 whorls.

This is undoubtedly the form Ancey identified from there as *T. cincta* (Journ. of Malac. xi, 1904, p. 63).

11. T. sykesii C. & P., n. sp. Pl. 55, fig. 6.

The shell is perforate, ovate conic, brownish corneous with a broad pale band at the periphery, transparent, shining, nearly smooth, minutely striate with lines of growth. Spire conic, with slightly convex outlines. Suture scarcely impressed, distinctly margined. Whorls 8, nearly flat, slightly convex, slowly increasing, compressed, the last broadly ovate, faintly marked with a light broad band at the periphery, base convex, slightly tapering. Aperture rather small, broadly ovate. Parietal lamella strong, very oblique, slightly arcuate.

Columella nearly straight, expanded above the umbilicus, with two well developed lamellæ extending to the outer margin of the columella. Peristome thin, erect, slightly arcuate. Length 4.5, diam. 2.5, axis of apert. 1.8 mm. Height of parietal lamella 0.35 mm.

Hawaii: Hilo (Thaanum), Olaa (Thaanum, Cooke). Type no. 14194 Bishop Mus. Cotypes 33959 and 14018 Bishop museum; 111858 A. N. S. P. and in Mr. Thaanum's collection.

T. sykesii is closely related to *T. henshawi.* In the former the shell is shorter, stouter and the spire has slightly more convex outlines. The parietal lamella is stronger, with minute serrations along its inner margin and the *front end is usually eroded.* In *T. sykesii* the columellar folds are more strongly developed. A pale peripheral band is never present in *T. henshawi.*

The shell differs from *T. a. hawaiiensis* by having two strongly developed and subequal columellar lamellæ, and the broad, outwardly flaring parietal lamella is eroded and irregular in front. It is three-fourths of a whorl long. Color cinnamon-buff. An Olaa specimen measures, length 4.4; diam. 2.6, length of aperture 1.75 mm.; 7¼ whorls.

It is less glossy and darker colored than *T. smithi,* and it has a much more prominent parietal lamella. The umbilicus is about one-eleventh of the total diameter.

In immature specimens the lower columellar fold is slightly stronger than the upper. There are about 12 fine low spiral striæ on the embryonic whorls.

11*a*. T. SYKESI ILLIBATA C. & P., n. var. Pl. 55, fig. 7.

In size, form and color-pattern this variety agrees closely with the typical form from Hawaii. The parietal lamella of *illibata* is lower, without the minute serrations on its inner margin and its front margin is never eroded. The columellar folds are much weaker. In young specimens the lower columellar fold is much stronger than the upper. There are about 12 distinct spiral striæ on the embryonic whorls.

Length 4.5, diam. 2.5, axis of apert. 1.8 mm. Height of parietal lamella 0.27 mm.

Molokai: Kilohana type locality (Cooke), Puunea (Pilsbry, Cooke). Type no. 34028 Bishop Mus., cotypes no. 24510 Bishop museum and 111859 A. N. S. P.

This variety is not quite as closely coiled as the typical form. There are 7½ whorls in the type of the variety which have the same length as the type of the species. The umbilicus is slightly larger than in the typical form, being about one-ninth of the total diameter.

12. T. CONVEXIOR P. & C., n. sp. Pl. 55, fig. 8.

The shell is perforate, light cinnamon colored, slightly transparent, with a somewhat dull surface. Outlines of the spire are distinctly convex, the individual whorls being slightly convex, the last rounded peripherally and below. Parietal lamella is broad, eroded or excised in front, and a whorl long. Two columellar lamellæ emerge; they are about equally prominent, but the upper one is more oblique. Length 4.4, diam. 2.4, aperture 1.5 mm.; 8 whorls.

Hawaii: Olaa, D. Thaanum; with *T. sykesi*. Type no. 112751 A. N. S. P.; cotypes in Bishop Mus.

T. henshawi, T. trochoides and *T. cincta* have distinctly less convex, nearly straight lateral outlines. *T. sykesi* is decidedly wider, with the parietal lamella not so long. *T. umbilicata* has a more slender spire and a shorter, wider parietal lamella. While we hesitate to add another to this difficult group, yet it does not seem possible to identify the shells with any described species.

13. T. ABBREVIATA (Ancey). Pl. 55, figs. 12, 13.

Shell obese-ovate, thin, more or less pellucid, glossy or with a somewhat silken sheen, light or brown-corneous, minutely but deeply and openly perforate. Spire conic, the apex minute, a little obtuse. Whorls 6½, regularly increasing, somewhat flat or very little convex, suture lightly impressed; the last whorl obese, rather sack-like, rounded (only in the young encircled by an angle). Aperture suboblique, irregularly oval, angular above, armed with a strong white compressed parietal lamella and two minute, oblique, spiral folds

(the lower one larger, the first sometimes obsolete). Peristome simple, acute, dilated and expanded at the columella. Length scarcely 4.0, diam. 2.5, alt. apert. 1.75 mm. (*Ancey*).

E. Maui: Kaupakalua (Baldwin), Kula, Kailua (Cooke). Cotypes no. 18421 Bishop Museum and 111850 A. N. S. P. Type not isolated by Ancey.

Tornatellina abbreviata ANCEY, Journ. de Conchyl. li, 1903, p. 298, pl. 12, figs. 7, 8.

T. abbreviata, which belongs to the group of *T. umbilicata* Anc., of the western part of Maui, is more swollen than the latter, and the parietal lamella, while robust, is less developed. It is quite a large perforate species, with the conic spire composed of 6½ nearly flat whorls separated by a shallow suture. The last whorl is swollen, well rounded, and not angular except in the young stage. The two columellar folds are small but distinct at this stage. In the adult they are less developed, and the upper one, which is perhaps a little less salient, tends to become effaced. The little circular perforation is covered above by the narrow expansion of the columellar margin (*Ancey*).

Recognition marks of this species are the obese shape and strong parietal lamella, which tapers in front and is not noticeably irregular or eroded there. Both columellar lamellæ are moderately developed in the neanic stage, the lower one being stronger, but in the adult only the lower persists, the other being visible as an obtuse convexity, visible in an oblique view in the aperture. A cotype from the Ancey collection is figured on pl. 55, fig. 13. It measures, length 3.7, diam. 2.5, length of aperture 1.75 mm., agreeing closely with Mr. Ancey's type measurements. Kaupakalua, East Maui.

The specimen figured in pl. 55, fig. 12, is larger than any in Ancey's material. It came out of the original lot from Mr. Baldwin, from which Ancey's material was taken. It has 7¼ whorls and measures length 4.6, diam. 2.95, axis of apert. 2.1 mm. Height of parietal lamella 0.32 mm. In adult specimens the umbilicus is one-sixth to one-ninth of the diameter. There are about 14 very fine spiral striæ on the embryonic whorls.

13*a*. *T. abbreviata hawaiiensis* n. var. Pl. 55, fig. 14.

Specimens of this species from Hawaii have a slightly lower parietal lamella and weaker columellar folds than those from Maui, but both columellar lamellæ emerge. They are also somewhat more slender. Length 4.3, diam. 2.5, axis of apert. 1.85 mm. Height of parietal lamella 0.25 mm.; 7 whorls.

Hawaii: Kukuihaele (type loc.), Okala and Waimea (Thaanum); Waimea fossil (Henshaw). Type 34026 Bishop Mus. Cotypes 15236 Bishop Museum, 111851 A. N. S. P., and in Mr. Thaanum's collection.

The fossil material is considerably larger than the living. A specimen with 7½ whorls measures, length 5.4, diam. 3.25, axis of apert. 2.3 mm.

In fresh immature specimens the lower columellar fold is stronger than the upper. There are about 12 rather separated fine distinct spiral striæ on the embryonic whorls.

14. T. SMITHI C. & P., n. sp. Pl. 55, fig. 11.

The shell is perforate, broadly conic, light corneous, vitreous, shining, nearly smooth, very minutely striate with lines of growth. Spire conic, apex subacute. Suture simple, lightly impressed. Whorls 6½, moderately convex, slowly increasing, compressed, the last somewhat ventricose with convex tapering base. Aperture not small, ovate. Parietal lamella low, oblique. Columella nearly straight, slightly tumid, furnished with two almost equal folds, which extend to the margin of the columella. Peristome simple, thin, acute, arcuate. Length 3.8, diam. 2.3, axis of apert. 1.8 mm. Height of par. lamella 0.15 mm.

Hawaii: Olaa, Kaiwiki and Hilo (Thaanum); Kaalapuuwale, in the district of Kona (Forbes). Type Bishop Mus. 14195. Cotypes Bishop Mus. 14015 and 14051, 111857 A. N. S. P., and in Mr. Thaanum's collection.

In most specimens the front portion of the parietal lamella is broken or eroded. The umbilicus is from 1/9 to 1/13 of the diameter of the shell. In immature specimens there are about 20 low close spiral threads on the embryonic whorls. This

species appears to be closely related to *T. abbreviata* of East Maui. It differs, however, in its more conical spire with more convex whorls, smaller umbilicus and lower parietal lamella.

The species is dedicated to Mr. E. A. Smith of the British Museum.

The specimens from Kaiwiki differ somewhat from the more widely distributed form. They are more obese, measuring length 3.6, diam. 2.7 mm. The parietal lamella is lower, about 0.10 mm. in height. There are two color varieties of this form; the typical vitreous-corneous and a single specimen of a uniform darker corneous color.

15. T. SHARPI P. & C., n. sp. Pl. 55, fig. 10.

The shell is perforate, rather broadly ovate-conic, light-cinnamon; glossy, very weakly striate. Outlines of the spire barely convex. Whorls 6½, convex, the last rotund. Parietal lamella rather high, excised in front. Columellar lamellæ two, subequal, the upper emerging to the edge, the lower slightly shorter. Length 3.3, diam. 2.2, aperture 1.4 mm.

Hawaii: crest of Kilawea crater, about half a mile south of the Volcano House, Dr. Benj. Sharp.

Similar to *T. abbreviata hawaiiensis*, but decidedly smaller. *T. stokesi* of Oahu is less conic in shape. The authors collected over about the same ground in 1913 without finding this species.

16. T. BALDWINIANA C. & P., n. sp. Pl. 55, fig. 5.

The shell is perforate, ovate-conic, corneous, transparent, shining, under a lens distinctly and almost regularly striate with lines of growth. Spire convexly conic, apex subacute. Suture simple, well impressed, indistinctly narrowly margined and minutely crenulate. Whorls 6½, convex, increasing slowly and regularly, the last tapering towards the base. Aperture proportionately large, oblong-ovate. Parietal lamella low, entire, scarcely diagonal. Columella tumid above, with two low folds, the upper slightly stronger than the lower. Peristome thin, acute, uniformly arcuate. Length 3.4,

diam. 1.95, axis of apert. 1.45 mm. Height of parietal lam. 0.11 mm.

W. Maui: Maunahooma (Cooke). Type no. 34029 Bishop Mus. Cotypes no. 21013 Bishop Mus. and no. 111854 A. N. S. P.

The most aberrant species of the genus. At first glance it appears to be a *Tornatellides*, but the animals are oviparous. This species is smaller and has fewer whorls than any of the other species; the whorls are more convex, and the columellar folds are quite weak and diagonal. In young shells the columellar folds are remarkably weak, but the parietal lamella is proportionately stronger than in adults. The shell is distinctly striate. The embryonic whorls are distinctly encircled with about 20 spiral striæ.

The shell is stouter in form and has a longer parietal lamella than *Tornatellides bellus* or *T. plagioptyx*, species which otherwise somewhat resemble *T. baldwiniana*.

ADDITIONS AND CORRECTIONS.

PAGE 44. 2d line under A. LINEOLATA (Newcomb). Read *lineolata* card in place of *lineolata* cord.

PAGE 73. *Key to species of Oahu.* In the third and fourth lines the phrase *whorls of the spire but slightly convex* was misplaced. It belongs in the following paragraph following the guide-letter *a*.

PAGE 121. Second paragraph from bottom. The Sunday Island form is perhaps referable to typical *E. ovatum* rather than to the variety *apertum*.

PAGE 125. 7th line from bottom. For *Tornatellina manilense* read *Tornatellina manilensis*.

LEPTACHATINA.

The following species probably belongs to this genus. It is unknown to other authors, and as the type is lost, it may be disregarded as unidentifiable.

Bulimus pumicatus Mighels. Shell dextral, conical, polished, glossy, light brown color, imperforate; whorls 7, slightly convex; aperture oval, small, with a delicate fold on the left side;

lip simple, acute. Length one-fifth, diam. three-twentieths inch. Oahu. (Proc. Boston Society of Nat. Hist. II, 1845, p. 19).

P. 36. After *A. obscura puella* add: Pl. 6, fig. 11.

Fernandezia.

F. diaphana (King).

Shell subcylindric, diaphanous, transversely striate. Length five-sixteenths, width five-thirtyseconds of an inch. Juan Fernandez (*King*).

Achatina diaphana King, Zoological Journal v, 1830-31, p. 342.

Tornatellina.

Tornatellina norfolkensis Preston.

Shell subulately cylindrical, thin, fragile, semi-transparent, smooth, polished, shining, pale reddish-brown; whorls 6, the first very small, the second proportionately large, the remainder regularly increasing, marked only with irregular growth-plicæ; suture impressed, very narrowly margined below, columella whitish, developed into a rather twisted, inwardly-projecting fold, and extending above into a light, well-defined, and somewhat restricted parietal callus, which reaches to the upper margin of the labrum; labrum simple, aperture inversely auriform, bearing a single, curved, erect, white, entering, parietal lamella. Alt. 3.5, diam. maj. 1.25 mm. (*Preston*, Annals and Magazine of Natural History, 8 ser., vol. 12, p. 536, Dec., 1913.)

Ball's Bay, Norfolk Island (*R. Bell*).

Tornatellina norfolkensis moohuensis Preston.

Shell differing from T. norfolkensis, Preston, in its very slightly shorter and much broader form, and in the parietal lamella, which in the present species is quite obsolete. Alt. 3.5, diam. maj. 1.5 mm. (*Preston, t. c.*, p. 537.)

Moohu Stone, a small islet off the coast of Norfolk Island (R. Bell).

Tornatellina norfolkensis nepeanensis Preston.

Shell allied to both T. norfolkensis and T. moohuensis, but differing from the former in its much broader form and from the latter in its more tapering spire, more rounded whorls and well-developed parietal lamella. Alt. 3.5, diam. maj. 1.5 mm. (*Preston*).

Nepean Island (R. Bell).

With the exeeption of *Vallonia* sp., whieh is exceedingly plentiful, this and the following are the only living speeies of land Mollusea found upon the Island (*Preston, t. c.*, p. 537).

Tornatellina duplicilamellata Preston.

Shell fusiformly ovate, polished, shining, yellowish-brown; whorls 5; regularly but rather rapidly increasing, somewhat inflated, marked only with growth striæ; suture impressed; columella margin white, twisted, bearing a short projeeting lamella above, deseending below in an almost vertical eurve; aperture rather obliquely, inversely auriform, furnished with a well-developed, entering, parietal lamella. Alt. 2.25, diam. maj. 1.5 mm. (nearly) (*Preston, t. c.*, p. 537).

Nepean Island (R. Bell).

P. 150. The name *Lamellina* Pse. proves to be preoccupied by Lamellina Bory de Saint-Vincent, Eneycl. Méth., Zoophytes II, p. 480, 1824. It must therefore take the name *Lamellidea*, which was eonsidered a synonym in the text.

EXPLANATION OF PLATES.

NOTE.—Unless otherwise stated, the figures represent specimens in the collection of the Academy. All original figures of shells were drawn by Miss Helen Winchester; those of the soft anatomy by Pilsbry.

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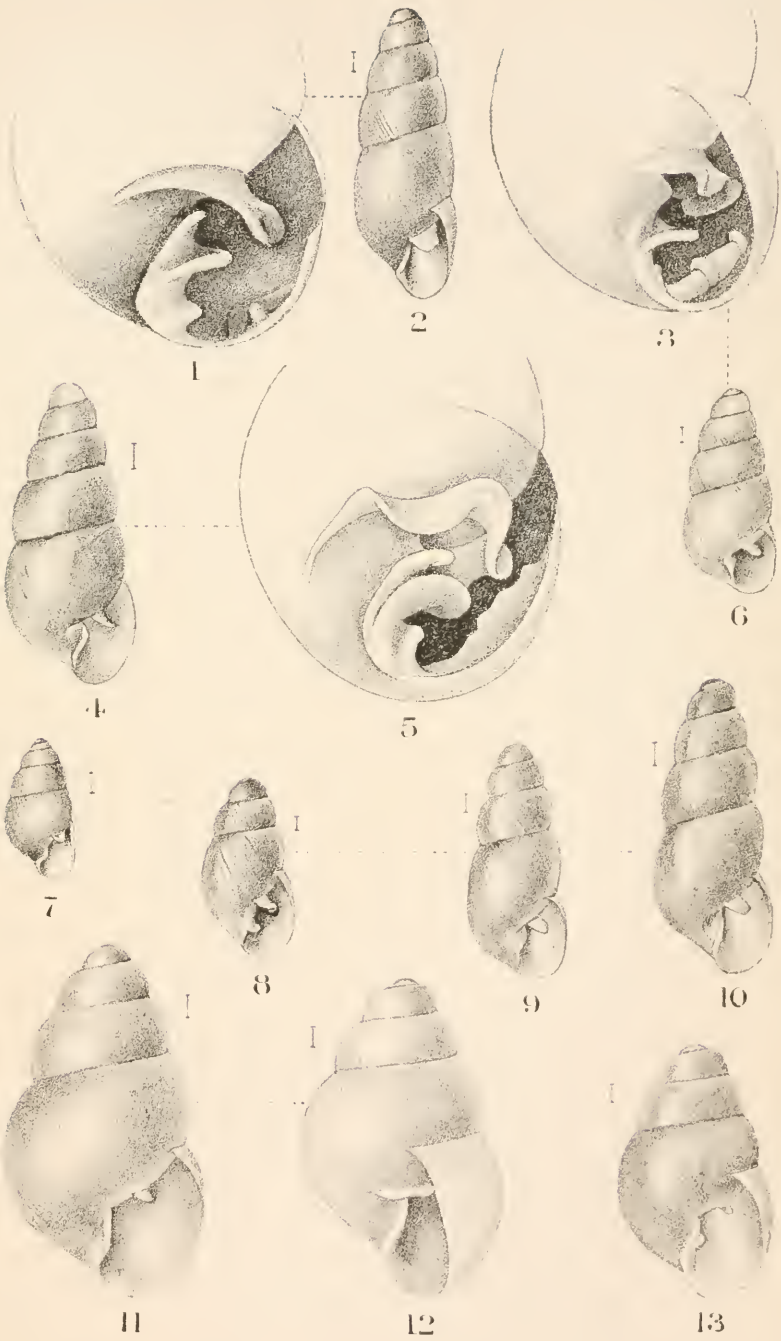
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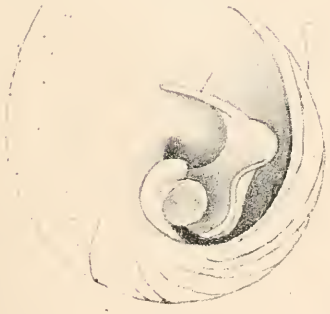

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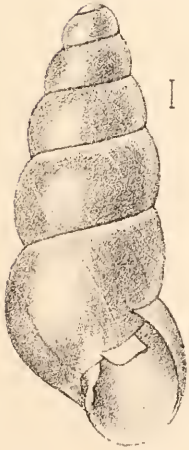

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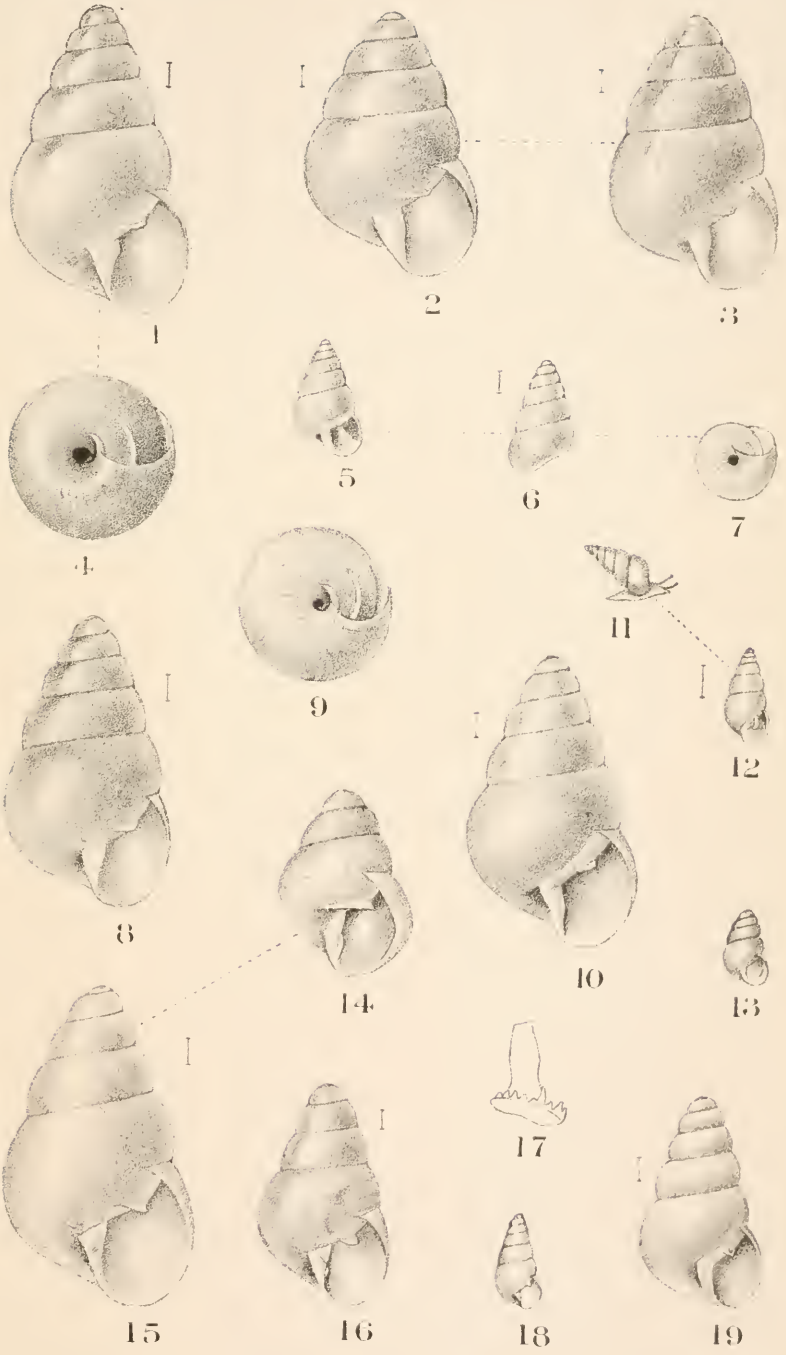
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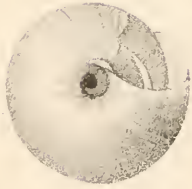

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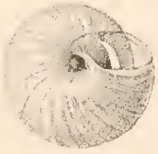

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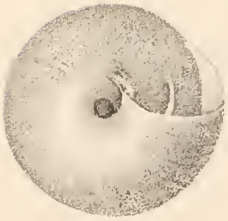

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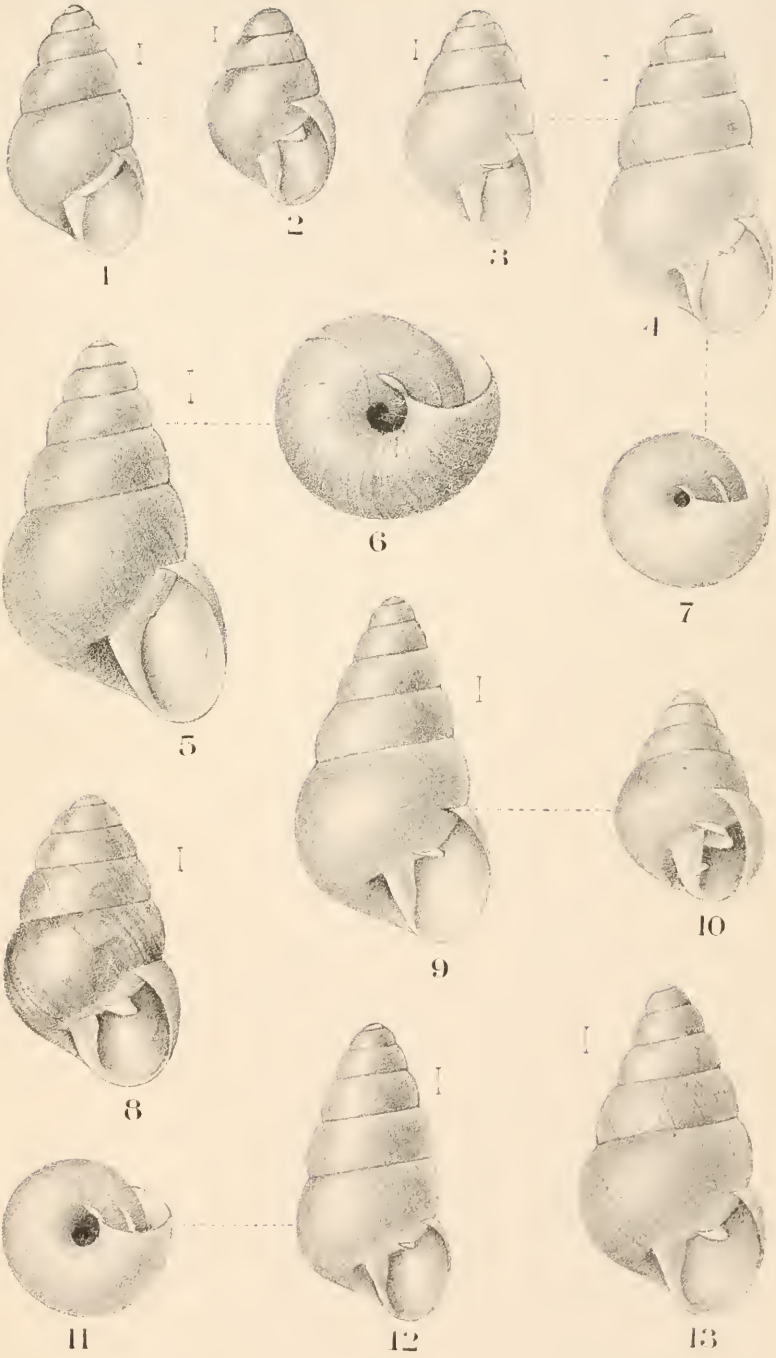
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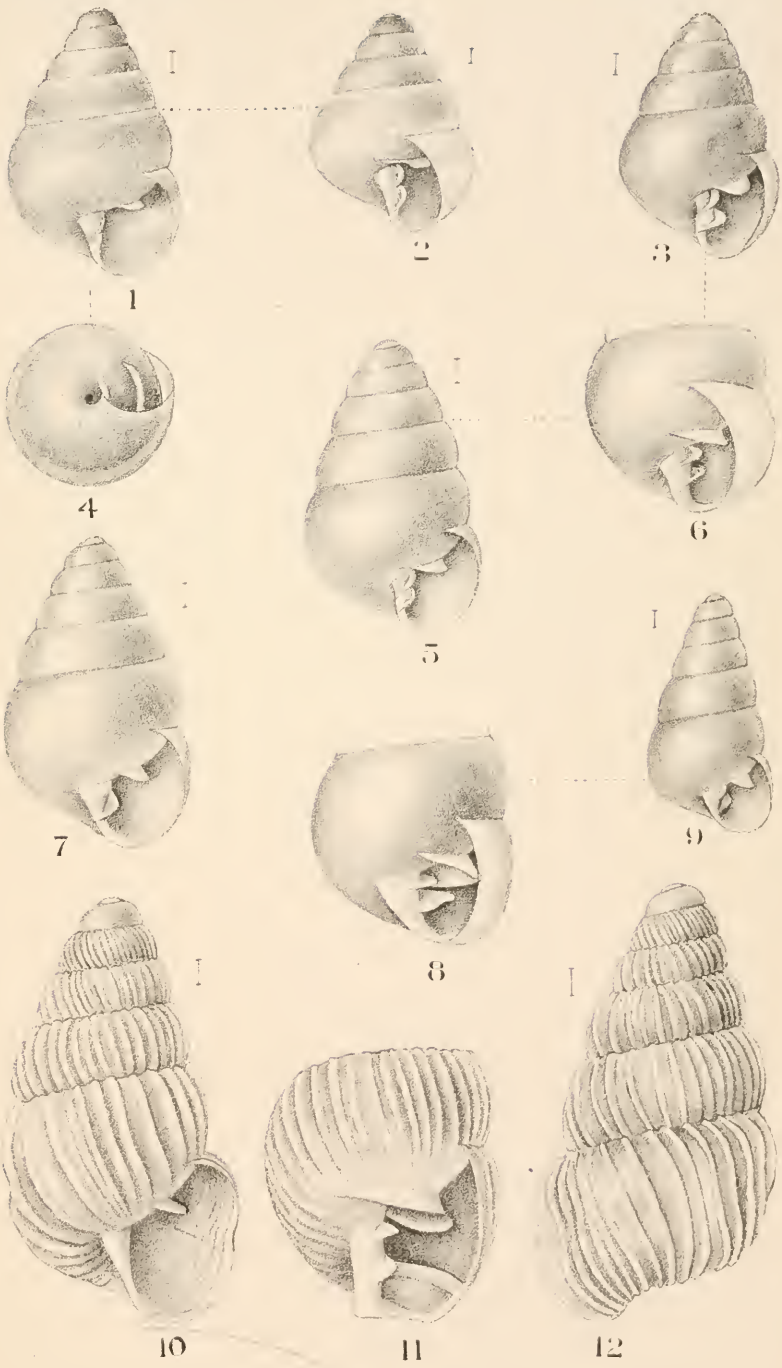
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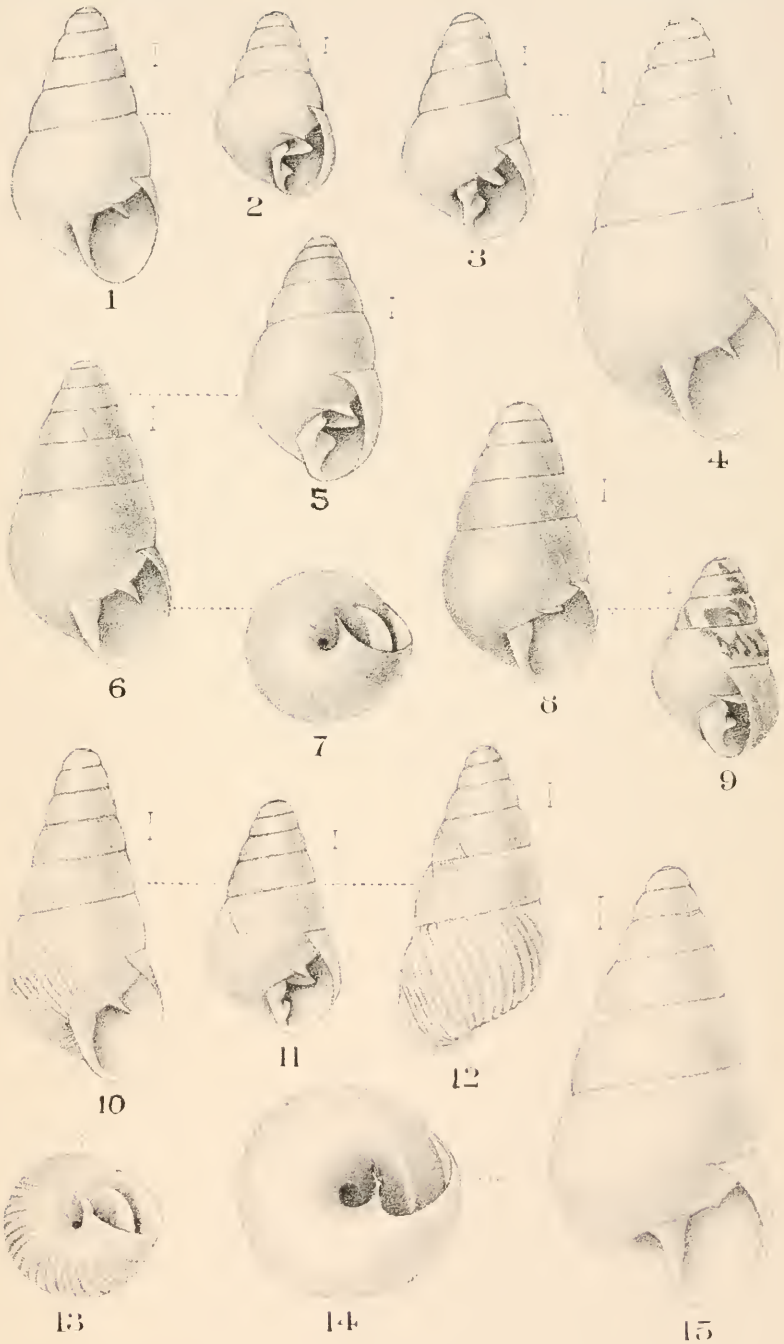
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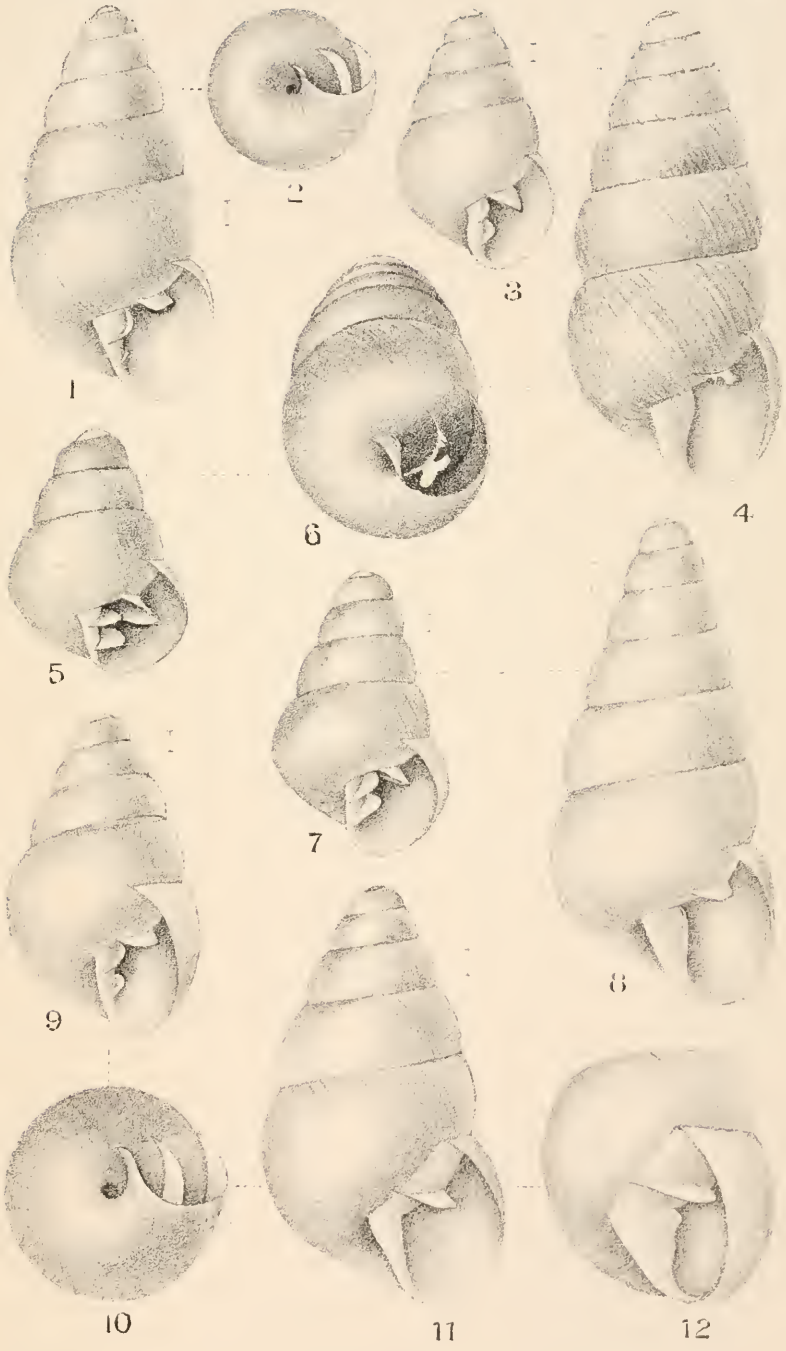
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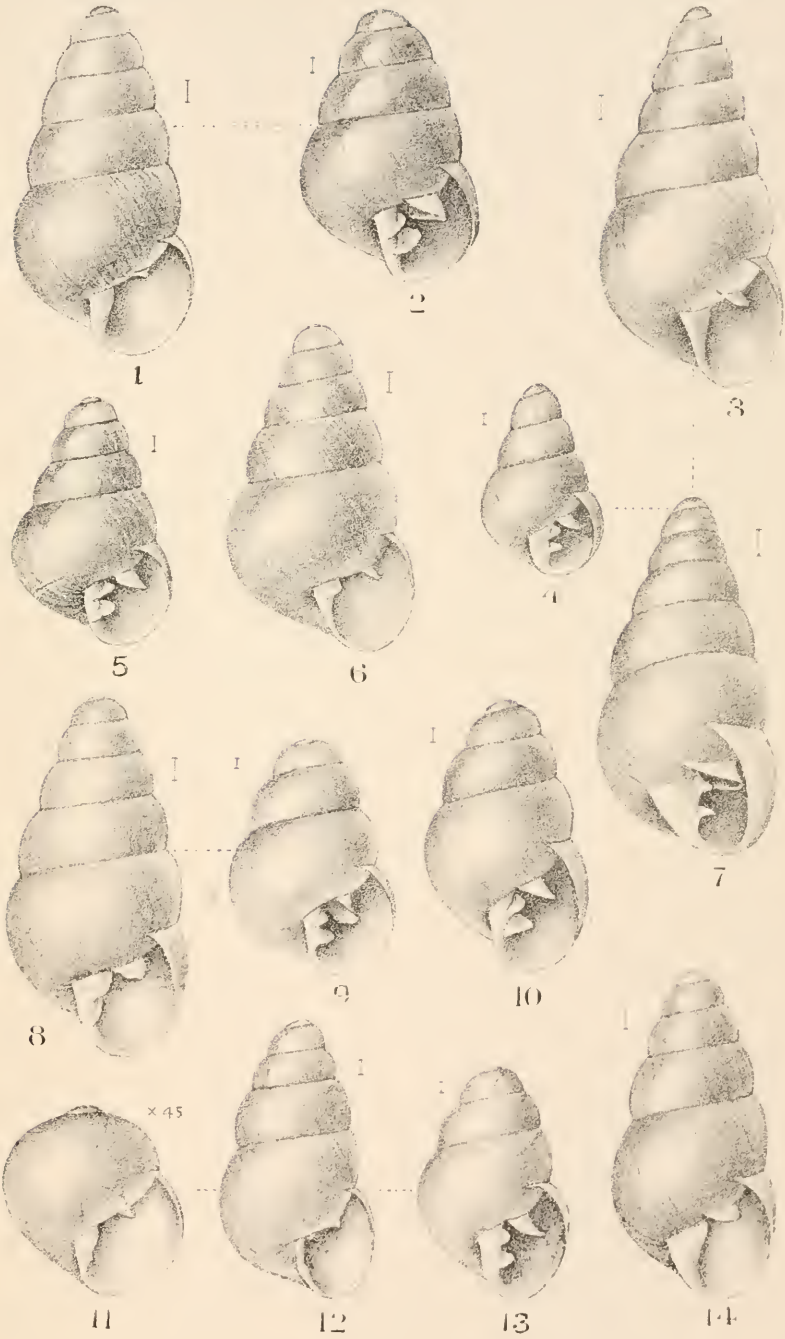
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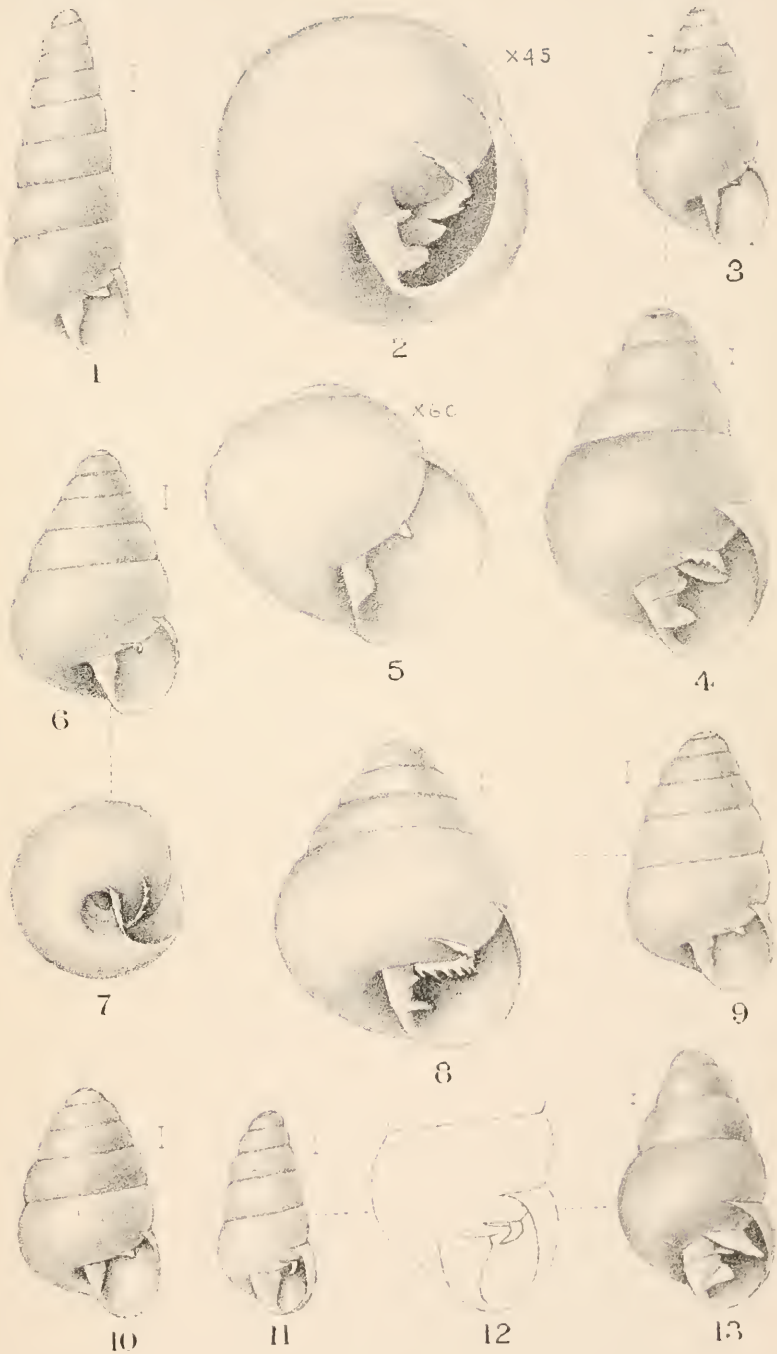
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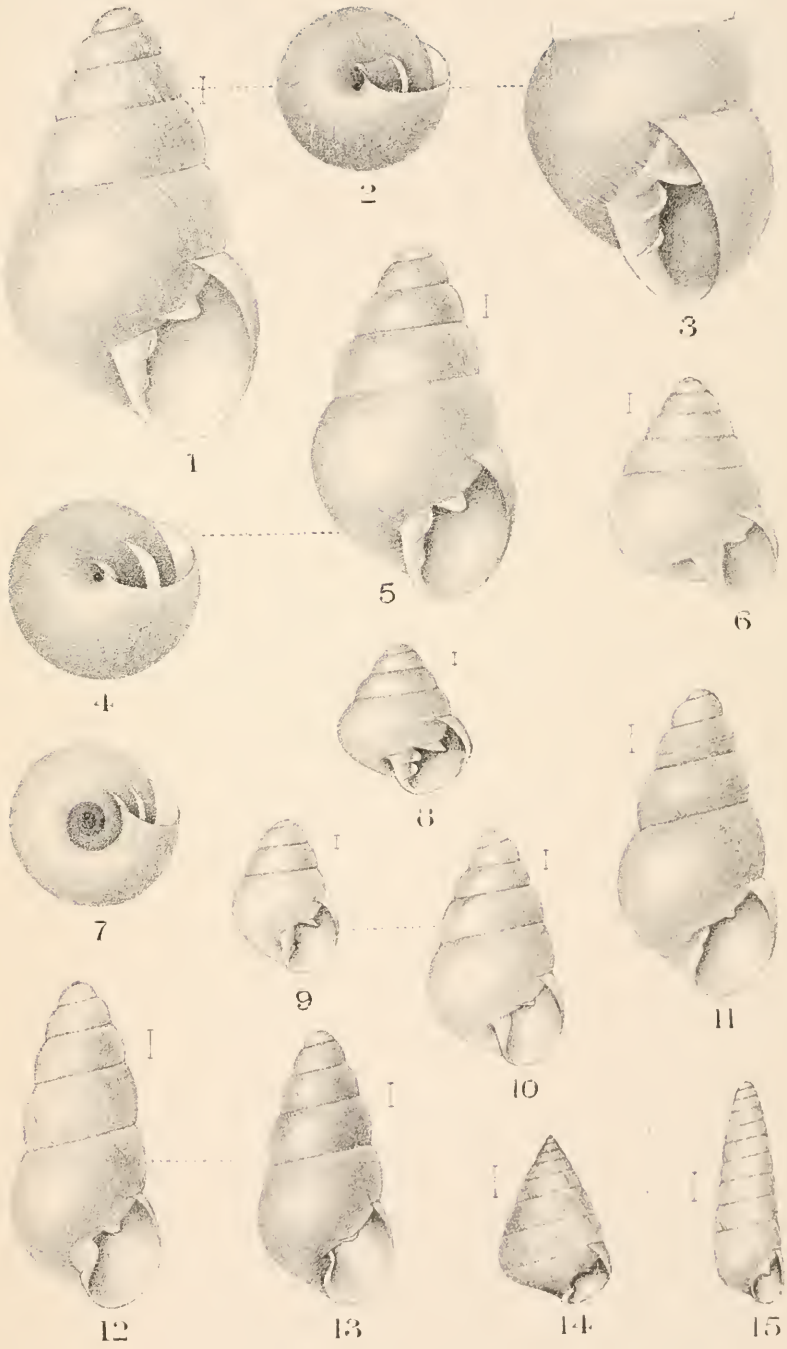
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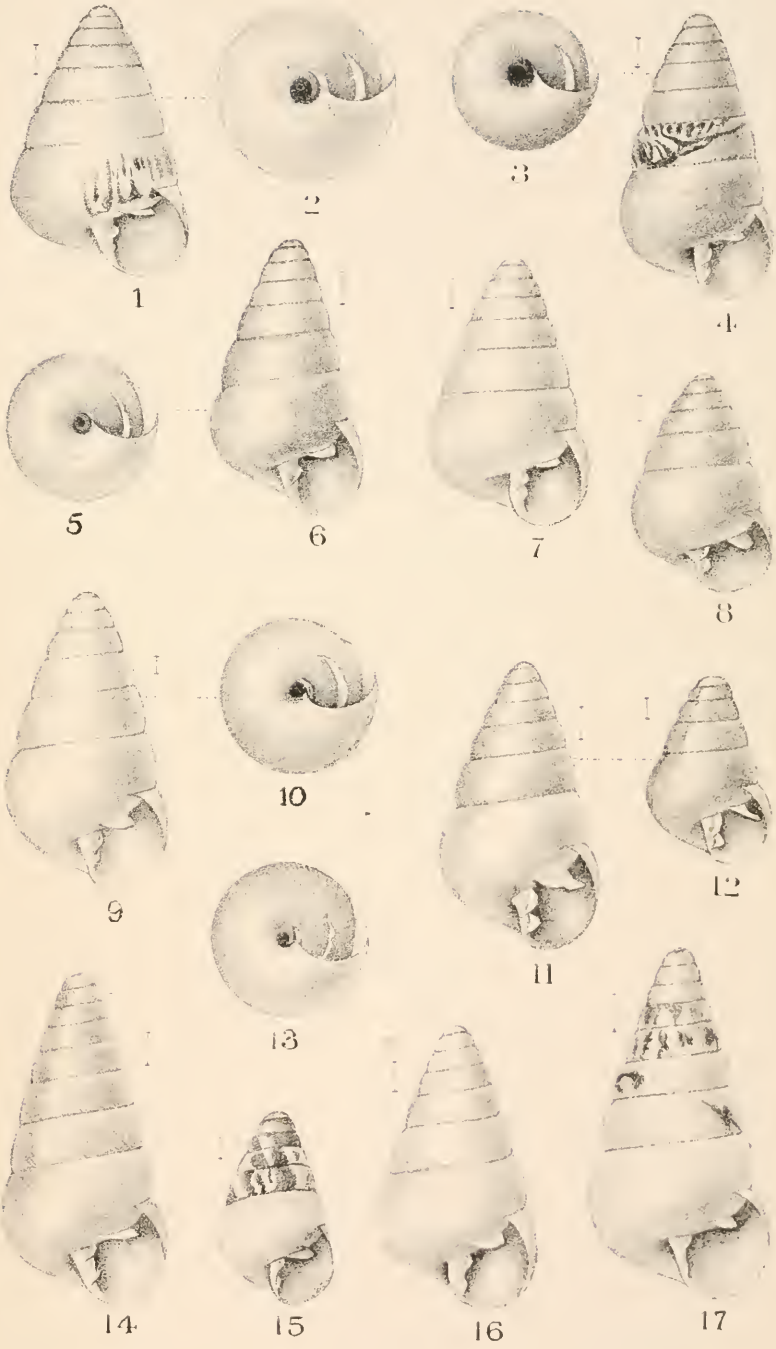
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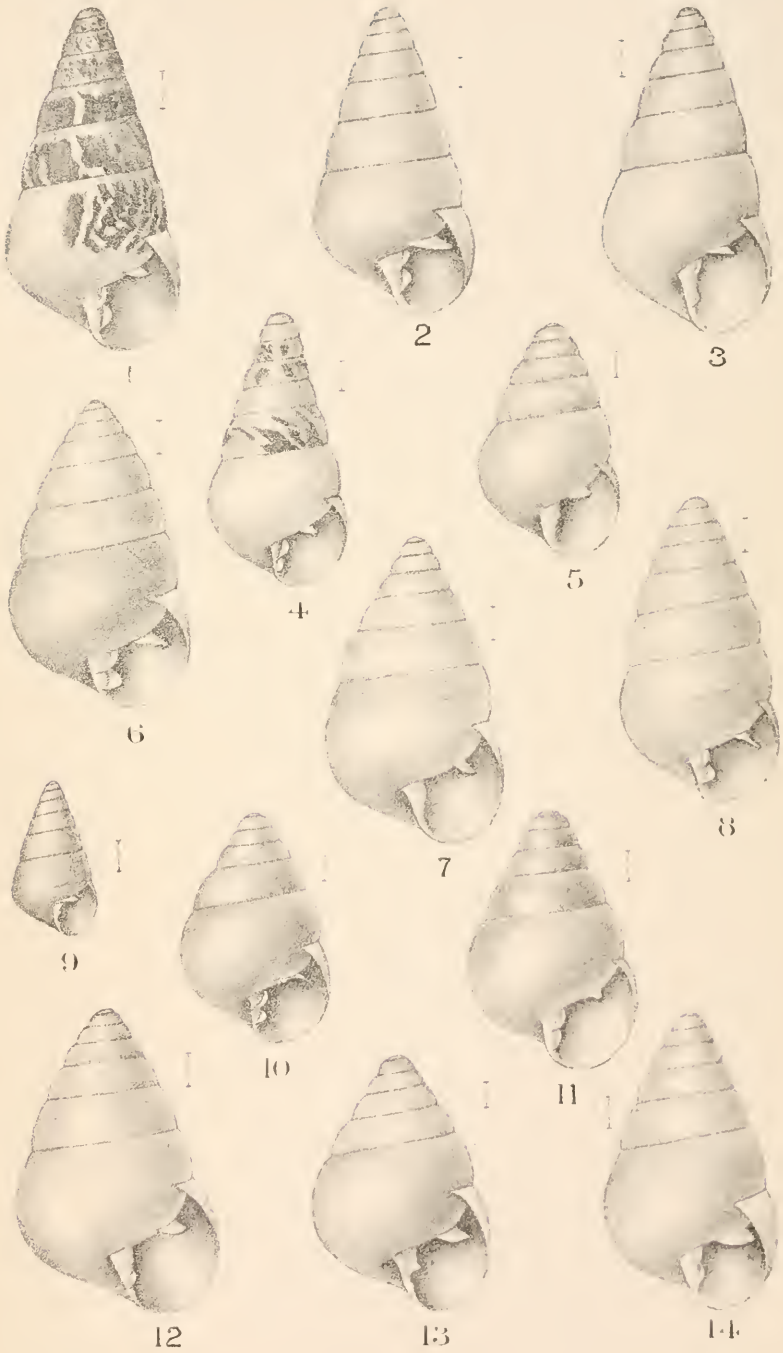
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